



# S SERIES USER MANUAL

The latest version of this manual is contained in the Windows software helpfile available for download from [www.dtafast.co.uk](http://www.dtafast.co.uk). The latest software and wiring diagrams are also available from the same site.

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## WHATS NEW WITH DTASwin & THE S SERIES

DTASwin is a major new release of our control software to match the new S series ECU's. It can only be used with the S series. Improvements are as below.

Communications with the PC can use a CAN network with a suitable adapter from us. This improves reliability and speed dramatically. RS232 communications have been totally re-written from the ground up.

Full copy/paste/manipulate functionality is built in.

There is no limit on the number of open windows even when working on line.

Much improved log manipulation and graphing facility is built in to the S series. A fast logging option is built in to properly map throttle transients and shift cut settings.

Any map changes which require a system reset are now handled automatically.

Full two stroke capability is built in.

Full sensor calibration charts are included with default buttons for ease of setting.

Real time mapping now uses real copies of the advance and fuel maps so you can make changes manually whilst mapping.

File names are now 30 characters with a 250 character comment field.

Diagnostic display has many more items added including current switch positions to aid set up.

Oil pressure, fuel pressure, oil temperature and gear pot are now included in the input sensors.

Throttle transient compensation has been completely reworked and now includes transients both ways.

The idle control main PWM map is now interactive to aid setting of this particularly time consuming set up job.

Sequential injection now has a separate injection angle table for odd engines like the BMC "A" series and sequential operation can be delayed until the engine starts if the cam sensor on the engine has insufficient signal at cranking. The injector wiring arrangement has been changed to incorporate this.

ECU Firmware flash upgradeable from the PC.

All ways that units have been damaged in the past have been taken account of in this new design and protection measures introduced to stop it happening.

Pull up resistors for external coil amps are now built in so they do not have to be added in the loom.

RPM Limit 20,000 rpm.

There are thousands of other improvements which you will find in use. People already familiar with DTAWin software will have no difficulty in adapting to the new product.

## QUICK START

All units are supplied with a map installed. This is a real map with conservative advance timing and fuel figures for correctly sized injectors. These values will start most engines. The following steps will get the engine running quickly.

- 1) Determine how you are going to run the engine, that is, sequential or non sequential, wasted spark or individual coils. This determines whether you will need a cam sensor.
- 2) Install the ECU and wiring loom as per the wiring diagram (at the end of this manual, pay attention also to the wiring notes pages) or just attach a loom from us. Although the S series is strong and waterproof it is best to install the unit in the cab of the vehicle.
- 3) Install the software on the PC and if you are using a CAN adaptor install the software for that also. If using RS232, make sure you set the DTASwin software to the correct number of the port you are using. See menu option *File/Serial Port Options*. The CAN adaptor will be found automatically.
- 4) Turn on the ECU and connect the chosen COMS cable (RS232 or CAN) before launching the software. Press the connect button which will appear.
- 5) Unlock the map using the *Padlock* icon on the tool bar or using menu item *File/Map Locking* or click on the red "Map Locked" rectangle on the status line at the bottom of the screen.
- 6) Go to *Essential Map Settings*. The following menu items must be set before the engine can be started.

### *General Engine Settings*

#### *RPM Range*

#### *Main Map Columns*

#### *Coil Per Plug Settings*

#### *Sequential Injection*

#### *Throttle Stops*

If you do not understand any of the numbers required in these maps then consult the relevant sections of the manual.

These are the very minimum of steps required to attempt to start your engine. In the directory C:\DTASwin\maps you will find a selection of maps. This selection will be increased over time and there may be one there for your engine although the specification is unlikely to be the same. If so use the menu option *File/Open* (or the folder icon on the tool bar) to send this to the ECU.

If the above is done correctly the engine should start or at least attempt to. Use your ears and knowledge of engines to determine if the engine has too much or too little fuel. If using a Dyno Control box then turn on the knobs and set them coarse (you can do this by clicking on *Knobs On* and *Knobs Fine* on the status bar at the bottom of your screen). You can then keep the engine running by swinging the fuel knob. When running use a timing light to check that the advance the PC is showing is the same as the engine is seeing. Use *Real Time Mapping/Main Display* to see the current advance. Run the engine at about 2000 rpm to do this. If the two disagree alter the Sensor Position in *Essential Map Settings/General Engine Settings* until they do.

- 7) If the engine will not start.

Make sure all connections are correct. **Pay particular attention to the crank sensor wiring as it is critical that a magnetic sensor is wired the correct way round.**

Check all your sensors are reading sensible values in *Real Time Mapping/Main Display*. If not and they are known not to be faulty, check the settings in *Engine Configuration/Sensor Scaling* are correct.

Go to *Display and Test Functions/Test Injectors and Coils* and make sure they are all working. Also ensure that you have a minimum of 3 bar fuel pressure.

Turn off sequential injection, this will eliminate the cam sensor if not running individual coils.

Go to *Display and Test Functions/Diagnostic Display* and make sure that all connected sensors are showing as OK. If not find out why. Check that External 5 Volts is showing about 5000. If it is not you have a shorted sensor somewhere.

Whilst in *Display and Test Functions/Diagnostic Display* crank the engine and make sure that you see an RPM with no crank errors. If you do not then you either have a mechanical or electrical problem with the crank wheel or sensor or you have made errors in *General Engine Settings*.

When all the above have been correctly identified and corrected, try again.

## **SOFTWARE INSTALLATION**

Insert the CD. If the software does not start to load immediately then switch to the CD drive from Windows Explorer. Double click on Setup. Unless you know about PC's install the software in the default directory offered. With certain flavours of Windows you may have a problem with the programme locating certain files it needs. This is not us, it is Mr Gates boys. The default directories for all important information are as below.

Programme	C:\DTASwin
HELP FILE	C:\DTASwin (This is the one most commonly lost by windows, annoying given that it is a bit important!)
Maps	C:\DTASwin\maps
Display Settings	C:\DTASwin\display

Set the Com Port (Menu:- File/Serial Port Options) to the COM port you are going to plug into. If your machine does not have a COM port contact us about an approved USB -> COM port adapter. We can also provide a CAN adapter. These are more expensive but are faster and give more reliable communications.

## **DEFINITION OF TERMS**

### **CALIBRATION UNITS USED**

Temperature	degrees Centigrade	(C)
Time (fuel flow)	pulse length in milli-seconds	(ms)
Engine speed	revs. per minute	(rpm)
Engine turns	rotations from starter engagement	(plain number)
Ignition	degrees before top dead center	(degs. BTD)
Throttle opening	percentage of throttle opening	(%)
Dwell	percentage of time coil turned on	(%)
Exhaust	rich/weak indication	Lambda number
Pressure	kpa of inlet pressure	(kpa) 100kpa = 1 atm

## MAP EDITING KEYS

- F1 Help
- F2 Copy
- F3 Paste
- F4 Exit and store changes to engine
- F5 Manipulate highlighted cells

IN 20 x 14 Main Maps

Alt Up Arrow	Nudge Cell to Higher Value
Alt Down Arrow	Nudge Cell to Lower Value
Alt Page Up	Coarser Nudge Cell to Higher Value
Alt Page Down	Coarser Nudge Cell to Lower Value

OTHER KEYS

## CURSOR KEYS

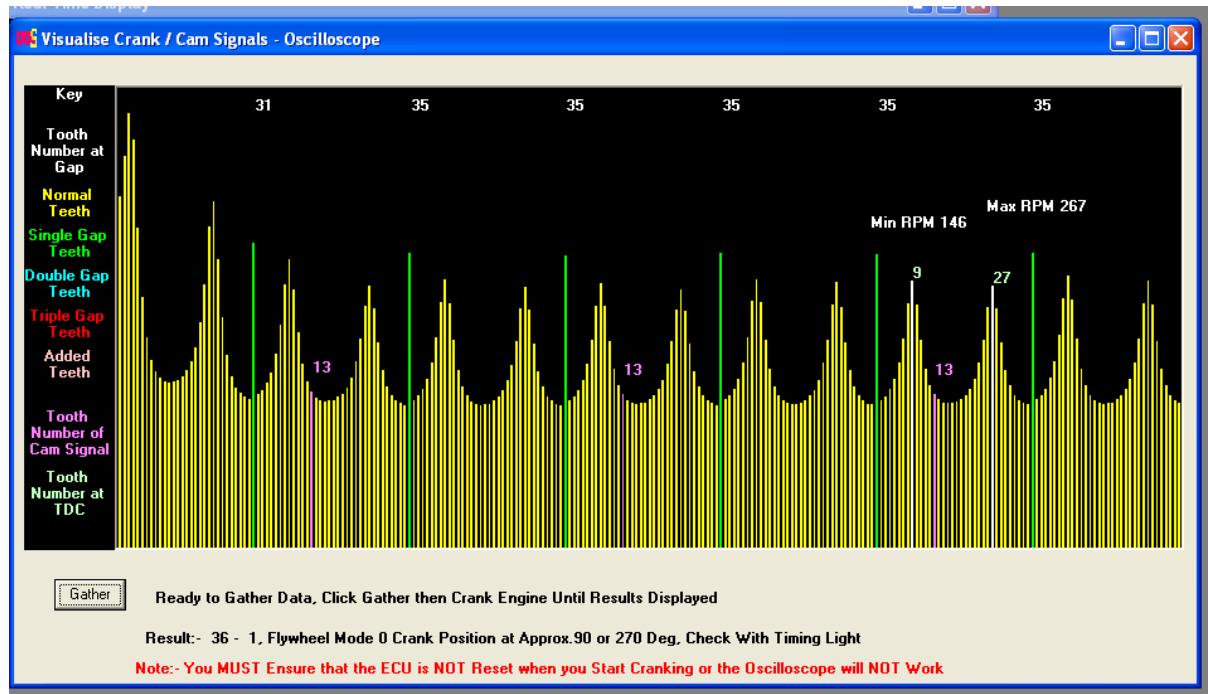
## Move about maps

## **IN REAL TIME MAPPING**

Shift F7	Ignition+
Cntrl F7	Ignition-
Shift F8	Fuel +
Cntrl F8	Fuel-
Cntrl P	Knobs on/off (toggle)
Cntrl C	Knobs coarse/fine
Cntrl K	Stop Engine
Cntrl I	Interp on/off
F6	Send Traced Cells to ECU
F7	Cam 1 target on left Dyno Box Knob
F8	Cam 2 target on right Dyno Box Knob

# CRANKSHAFT OSCILLOSCOPE

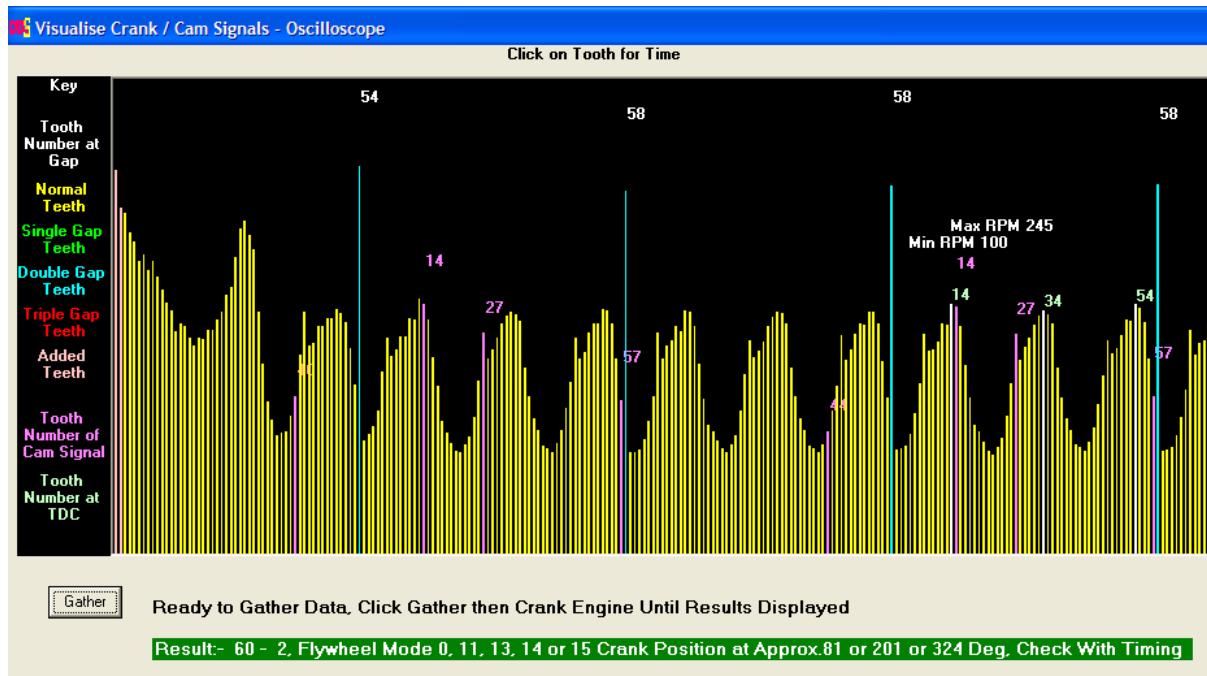
Windows menu:- *Display and Test Functions/Crankshaft Oscilloscope*



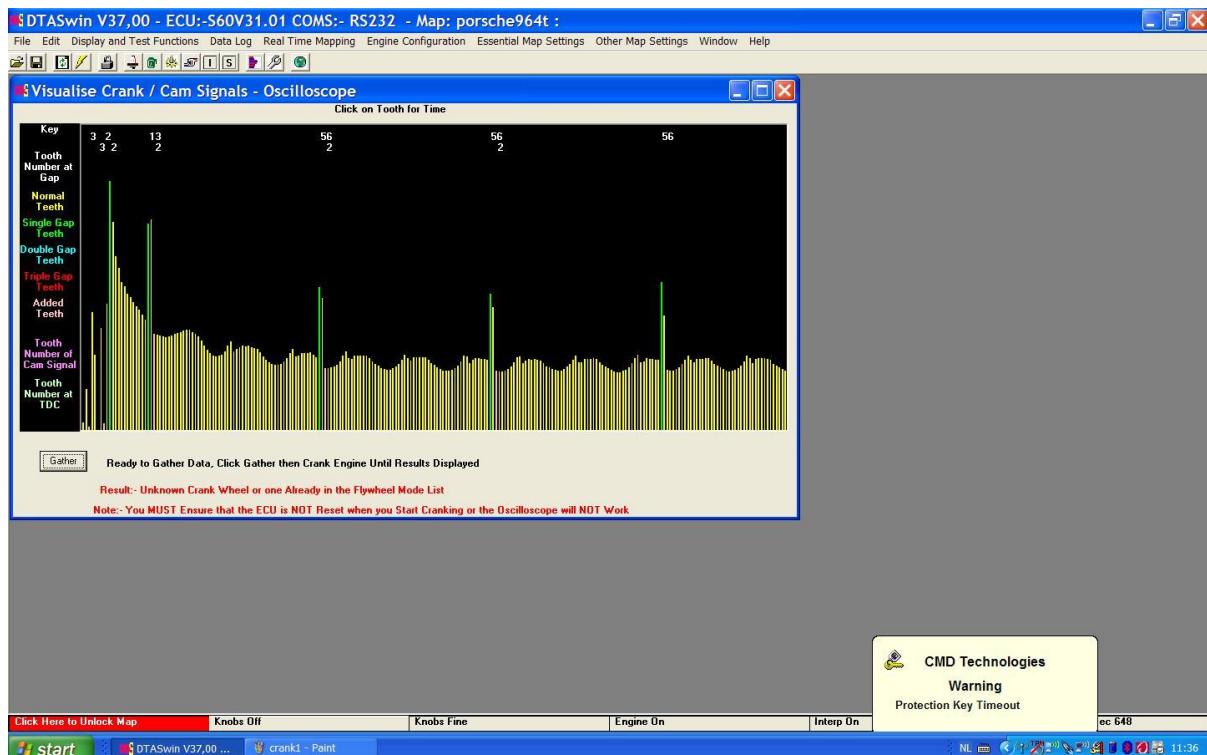
This is designed as an aid to starting an engine for the first time. Open the oscilloscope, press gather, crank the engine until the display as above is shown. For a single group of missing teeth the system will determine what is there and give you crank teeth numbers and missing teeth. An approximate position for the crank sensor is determined. Enter these in general engine settings and attempt to start the engine. When running use a timing light to get to the exact position for the crank sensor.

Note the crank mode is only determined for flywheel mode 0. Any other mode i.e. a specific engine like a Honda K20 then just load the sample map given with the software.

The crankshaft oscilloscope can determine various faults with the crank sensor and wiring. Particularly useful is it can determine the correct orientation of crank sensor wiring. Below is an excellent trace for a 60 – 2 wheel. Note this engine has a 4 tooth cam target resulting in multiple pink cam markers.

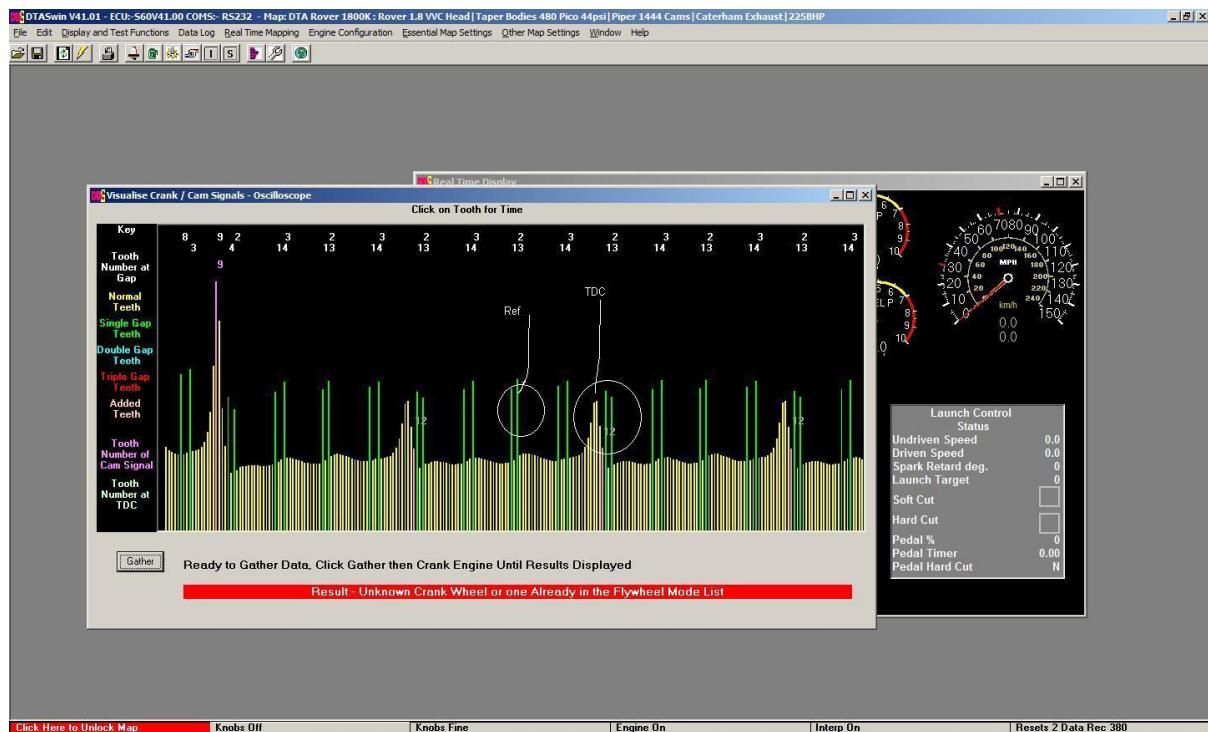


Note that the double gap tooth clearly shows as a blue line at tooth number 58, exactly what you would expect for a 60 – 2 wheel. Below is an example of a 60 – 2 wheel with the sensor connected the wrong way round.



Note that the gap appears as a single one with a green marker line and the next tooth after the green one is nearly as tall.

The crankshaft scope can also be used to determine which half of the four stroke cycle a cam signal is received. To do this remove all spark plugs except no 1. Generate a crankshaft scope picture as below.



This a Rover K series with a 4 gap crank wheel. It has a single tooth cam target . Note that now we only have one peak in the normal crank teeth, the yellow ones, per 2 rotations of the engine, this is circled in white marked TDC. 2 teeth after this peak is the cam signal, the tooth in pink, marked as tooth 12. As this engine has 36 teeth on the crank wheel, the cam signal is two teeth after TDC no 1 firing stroke so the correct entry in the cam position box in *Engine Configuration/Sequential Injection* is +20 degrees.

### SENDING A CRANKSHAFT OSCILLOSCOPE PICTURE TO DTA

We may ask you to email us a crankshaft oscilloscope picture to aid in remotely debugging your installation. To do this generate the picture as we ask you (either running or cranking).

Press the Save Pic button and choose a valid windows file name for the picture. This will save the picture as a .Bmp bitmap, the correct file extension will automatically be added. Make sure you remember where you have saved it! Email that as an attachment to [office@dtafast.co.uk](mailto:office@dtafast.co.uk).

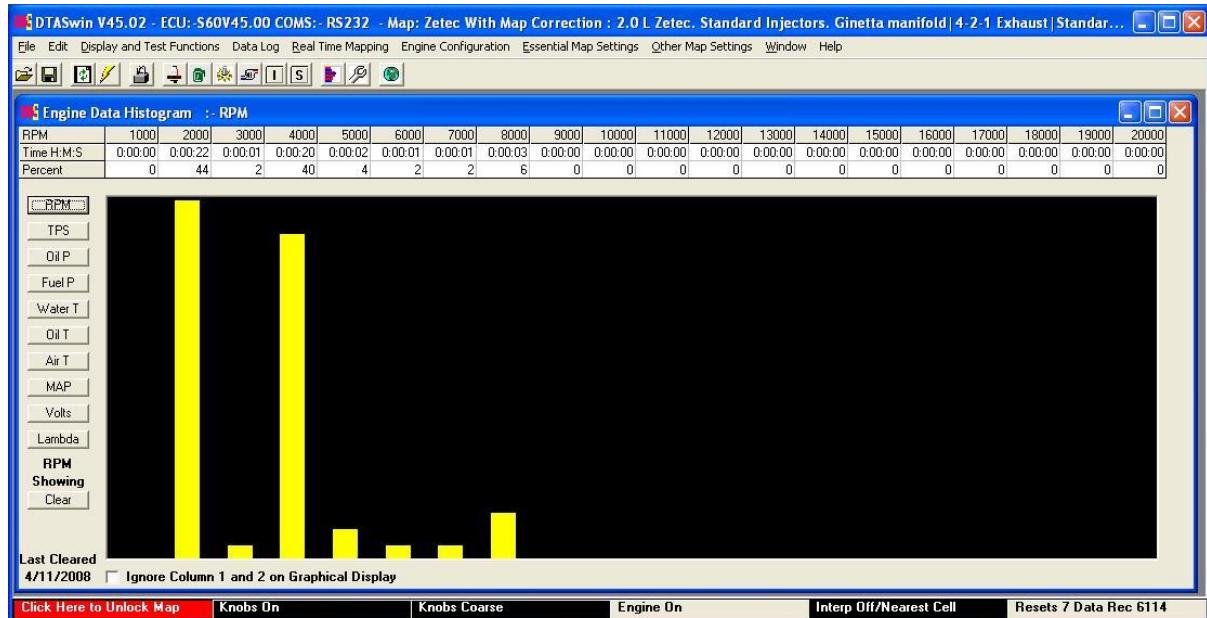
## **REAL TIME DISPLAY**

### *Display and Test Functions/Real Time Info*

This display gives a continuous read out of the current engine settings. These are grouped into three sections.

# ENGINE HISTOGRAM

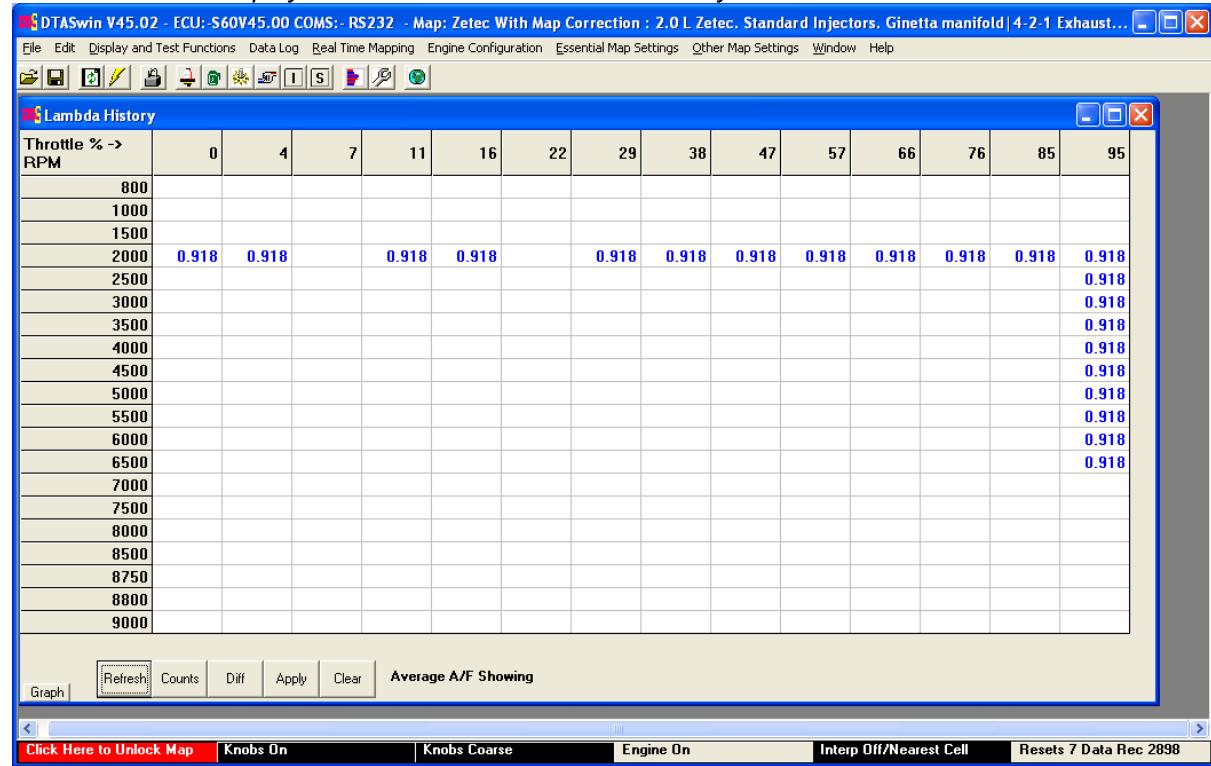
Windows menu:- Display and Test Functions/Engine Histogram



This is a record of the usage pattern of the engine. A bar chart gives a pictorial idea of the history of the chosen sensor, actual times are recorded down to the second and the percentage of the engine use this represents is also shown. A maximum of 18 hours can be recorder in any one "Bin".

# LAMBDA HISTORY

Windows menu:- Display and Test Functions/Lambda History



This is a record of the lambda values seen by a, preferably, wide band sensor in the exhaust of the engine. The average lambda value recorded in each cell during the current PC session is shown. Note this is stored on the PC not in the ECU. You can also view the number of “counts” of data averaged for each cell. High counts means that confidence can be placed in the lambda value in that cell, low counts implies that cell has just been passed through in a transient way and the value should be ignored.

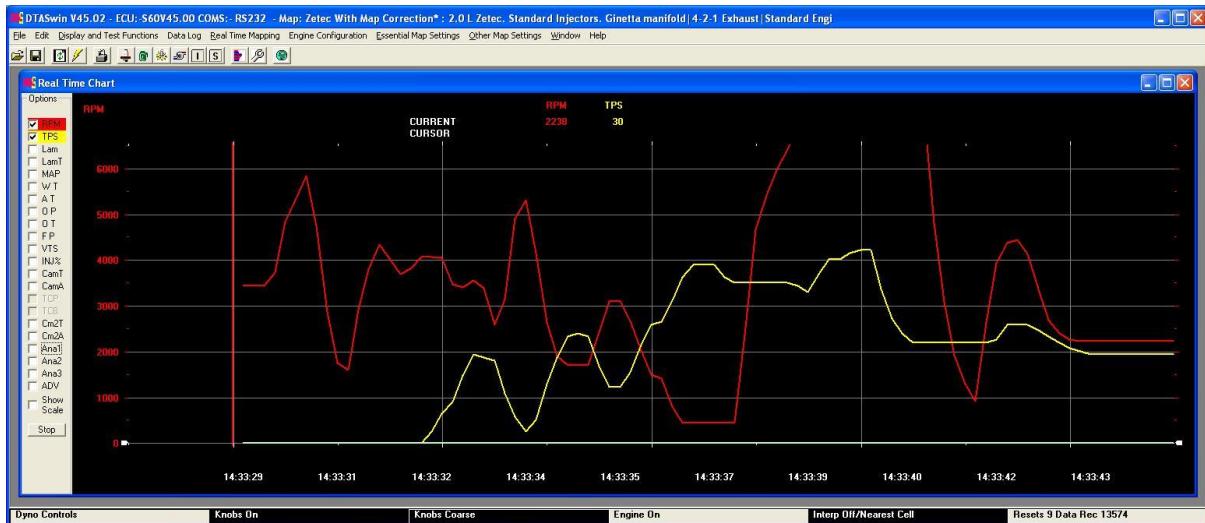
The difference between this and target lambda map can be displayed in percentage terms and this percentage applied to the fuel map if required.

use this represents is also shown. A maximum of 18 hours can be recorded in any one “Bin”.

# REAL TIME CHART

Windows menu:- *Display and Test Functions/Real Time Chart*

Shows in real time a chart of any of the items on the left menu of the screen.



Six items can be displayed at any one time. The chart can be slid from side to side, expanded or contracted by picking up the markers at the bottom of the chart.

Several hours of data can usually be collected.

# MEASURE INJECTOR DEAD TIME

Windows menu:- Display and Test Functions/Measure Injector Dead Time

This function provides a neat and simple method of measuring injector dead time in the normal running condition of the engine. Injector dead time is important when running compensations (MAP, air temp etc.) to ensure that the compensations are accurately applied. The test relies on the fact that if the dead time is correct then running the engine in two stroke mode with half the fuel numbers in the fuel map and four stroke mode with the full amount will produce the same lambda value.

To run the test do the following:-

Turn off Battery Compensations.

Turn off Sequential Injection.

Start Engine.

Open Real Time Chart and display Lambda.

Start Test.

Adjust the dead time in *Engine Configuration/General Engine Settings* until the lambda value does not change through the 4 stroke, 2 stroke change.



Dead time incorrect is shown above.



Dead time correct is shown above.

## MAIN IGNITION MAP

*Windows menu:- Essential Map Settings/Ignition Map*

Ignition map settings in RED of degrees BTDC.

If any of the cells are highlighted in green this indicates that the value of this cell has been set in Real Time Mapping whilst the engine was running.

To manipulate a group of cells then highlight the cells using the mouse and use copy/paste/manipulate from the edit menu.

A 3D Graph is always on screen This shows a "3D" wire frame graph of the map to allow ready visualisation of any "holes" in the map and other irregularities. Any point can be dragged with a mouse.

To send the changes to the ECU press F4 or click on the close cross and a confirmation message will be issued.

## MAIN FUEL MAP

*Windows menu:- Essential Map Settings/Fuel Map*

Fuel map settings in BLUE as the time any injector will remain open and flowing fuel, in milliseconds (0.001 sec). The injectors fire once every TWO revs i.e. once every engine cycle unless in two stroke mode.

If any of the cells are highlighted in green this indicates that the value of this cell has been set in Real Time Mapping whilst the engine was running.

To manipulate a group of cells then highlight the cells using the mouse and use copy/paste/manipulate from the edit menu.

A 3D Graph is always on screen This shows a "3D" wire frame graph of the map to allow ready visualisation of any "holes" in the map and other irregularities. Any point can be dragged with a mouse.

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## INJECTOR ANGLE MAP

Windows menu:- Essential Map Settings/Injector Angle Map

The injector angle is the point referenced to Top Dead Centre Firing Stroke when the injection starts or stops. Whether this angle affects the beginning or end of injection is defined in *Engine Configuration / Sequential Injection and Fan Control*. As a matter of explanation if the definition is set to end of injection and -90 is entered in this table then the injection pulse will finish 90 degrees BEFORE top dead centre.

Some engine builders think this is a very important number, others think it is of no importance.

To manipulate a group of cells then highlight the cells using the mouse and use copy/paste/manipulate from the edit menu.

A 3D Graph is always on screen This shows a "3D" wire frame graph of the map to allow ready visualisation of any "holes" in the map and other irregularities. Any point can be dragged with a mouse.

To send the changes to the ECU press F4 or click on the close cross and a confirmation message will be issued.

## MAIN MAP RPM RANGE

*Windows menu:- Essential Map Settings/RPM Range*

Setting a suitable RPM scale for the engine in use. Just type in new figures. Use enter rather than the cursor keys to confirm each change.

The scale must increase from top to bottom. The rpm bands can be of any size but we recommend a minimum spacing of 250 rpm. You can make the spacing closer than normal for any area of interest for your particular engine e.g. close together at low revs for a trials engine or close together at the high revs for a peaky race engine.

## THROTTLE TRANSIENTS

Windows menu:- Essential Map Settings/Throttle Transients/Throttle Transient Increase/Reduction Hot/Cold

Separate maps are provided for hot and cold engine conditions.

As on a carburettor, this gives a shot of fuel for a limited time as the throttle is opened quickly. Very difficult to quantify, often varying between individual engines even of the same type and capacity. Normally needed if there is any hesitation or uncertainty when opening the throttle quickly. Only experiment will yield the best results. If you have a very fast wide band sensor you can set the data log to fast mode and record the % increase or reduction as it is happening. Stop the engine and graph the throttle position, lambda and pump %. The object is to keep the lambda value as close to constant as possible through the throttle transient. The engine without an uplift will tend to go lean.

A similar effect occurs on throttle reductions the engine will go rich for a short time without some transient reduction.

The effect on closing the throttle completely on the overrun makes for lambda readings which indicate the engine is very lean. This is not the case and it should be ignored.

There are four different rpm bands to which it can be applied. Generally, you will need a higher percentage of fuel uplift for a longer time at lower pedal speeds in the lower rpm bands and probably nothing at all in the higher bands.

The pedal speed row is the percentage of throttle movement recorded during the Pedal Speed Measuring time. If in doubt start at 5 for the lower bands increasing to 25/30 in the higher bands.

A very low figure will cause the throttle pump to work even with very slow movements of the pedal and values above 50 will mean it will probably never come into operation at all depending on the pedal speed measuring time. Again careful use of fast logging will help to identify the engine requirements.

The current percentage change being generated by the transients can be seen in real time mapping screen to the right of the throttle percentage in the senor box. Note also that this position is used for start fuelling as well and this takes priority.

### SWITCH TO HOT MAP AT

Generally, an engine will need more transient fuelling when cold. We would normally switch maps at say 50C.

### PEDAL SPEED MEASURING INTERVAL

This is the time in ms over which the pedal movement is measured. 10 – 20 ms is a reasonable figure.

### TURN OFF TRANSIENTS FOR MAPPING

Transients can interfere with mapping steady state. This allows transients to be turned off for this purpose. Remember to turn them back on after steady state mapping is finished.

Press F4 to save the changes.

## AIR TEMPERATURE COMPENSATION

Windows menu:- Essential Map Settings/Air Temp Compensation

There is only one set of correct fuel compensation figures for this shown below.

The screenshot shows the DTASwin V45.02 software interface with the title bar "DTASwin V45.02 - ECU: -S60V45.00 COMS: - RS232 - Map: Zet...". The menu bar includes File, Edit, Display and Test Functions, Data Log, Real Time Mapping, Engine Configuration, Essential Map Settings, Other Map Settings, Window, and Help. Below the menu is a toolbar with various icons. The main window is titled "Air Temperature Compensation" and contains a table with 20 rows. The columns are labeled "Row", "Air Temp C -40 to 125", "Fuel Comp % -90 to 500", and "Advance Comp % -90 to 500". Row 6 is highlighted with a gray background. At the bottom of the table are two buttons: "Set" and "Set Fuel Compensation to Standard". A green bar at the bottom right says "Current ECU MAP". The status bar at the bottom shows "Dyno Control Knobs On Knobs Coarse Engine On Interp Off/Ne Resets 6 Dat".

Row	Air Temp C -40 to 125	Fuel Comp % -90 to 500	Advance Comp % -90 to 500
1	-10	9	0
2	-5	7	0
3	0	6	0
4	10	3	0
5	15	1	0
6	20	0	0
7	25	-1	0
8	30	-3	0
9	35	-4	0
10	40	-6	0
11	50	-9	0
12	60	-12	0
13	70	-15	0
14	80	0	0
15	90	0	0
16	100	0	0
17	110	0	0
18	115	0	0
19	116	0	0
20	120	0	0

This section sets the correction to the basic map settings depending on the inlet air temperature. As an example you may wish to reduce the amount of fuel and retard the ignition slightly (say 10%) at high inlet temperatures.

All three columns are user settable. Move the cursor to the cell concerned and change the relevant figures. Note if you are intending to implement air temperature compensation this must be done before mapping.

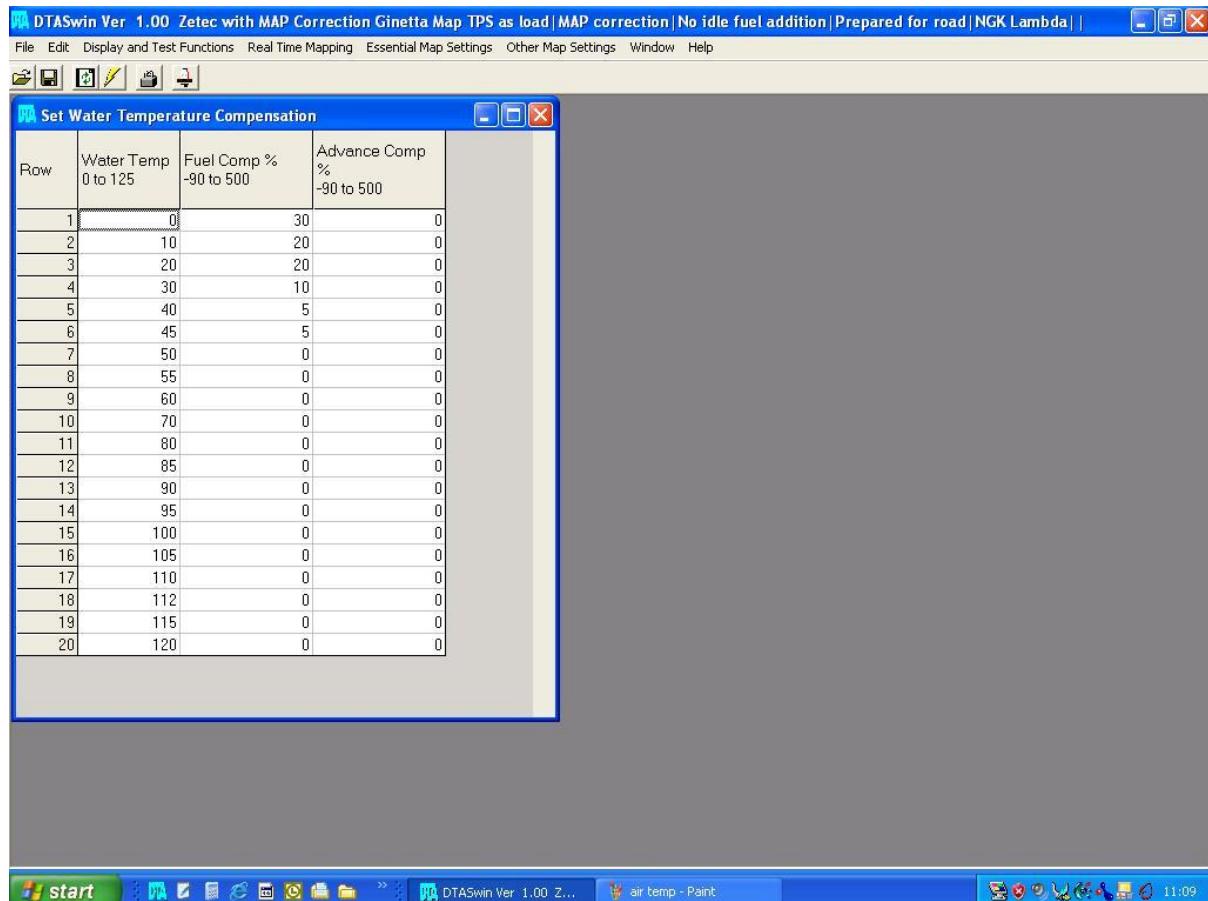
The "Set to Standard" button will set the fuel compensation for using a knowledge of basic science.

There are no other correct figures.

Press F4 to save the figures.

# WATER TEMPERATURE COMPENSATION

Windows menu:- Essential Map Settings/Water Temp Compensation



This section corrects the basic map settings depending on the engine water temperature. This provides the equivalent effect of a choke. As a general guide try gradually increasing the fuel increase percentage below 40 deg. C by about 20%. If the engine does not run cleanly on start up then either give it more or less fuel as required.

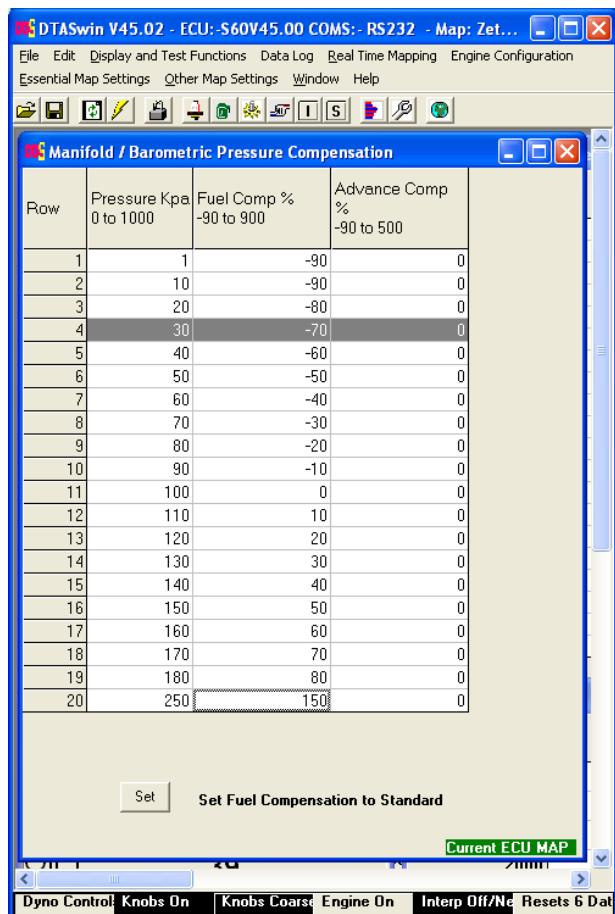
At DTA we no longer use this brute force approach to start fuelling and prefer to use the temperature and turns (effectively time) approach via the Start Fuelling Map. This if done correctly will reduce to the total amount of extra fuelling required especially when the engine starts from very low temperatures.

All three columns are user settable. Move the cursor to the cell of interest and change the relevant figures.

Press F4 to save the figures or ESCAPE to exit without saving.

# MANIFOLD PRESSURE / BARO COMPENSATION

Windows menu:- Essential Map Settings/Pressure Compensation



This section corrects the basic map settings for the engine inlet pressure or barometric pressure depending on where the sensor is fitted. If a barometric sensor is fitted then normally the fuel would be reduced at low pressures (to keep the mixture strength the same).

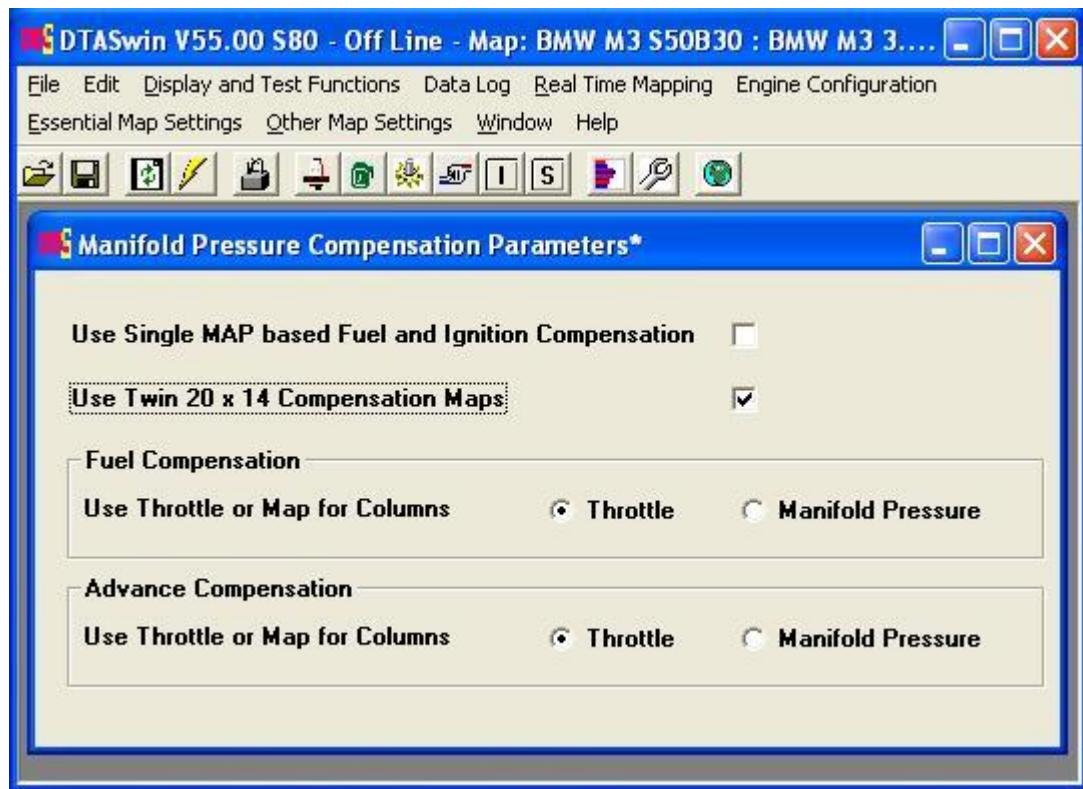
If the engine is a forced induction (or "blown") then it would be normal to make the main map reflect the "on boost" requirement and use the compensation map to accommodate the off boost situation.

All three columns are user settable. Move the cursor to the cell of interest and change the relevant figures.

NB The above shows a sample set of figures for automatic correction of fuelling for air inlet pressure. Only use these figures if a pressure sensor is fitted if it is not set all fuel corrections to zero. If using MAP correction, set this before mapping. If using MAP as load then compensation is not required.

The button Set to Standard will fill out the fuel compensation to the correct amount. This is 16<sup>th</sup> Century physics not black magic, use other figures at your peril.

### 3D MAP COMPENSATION TABLES

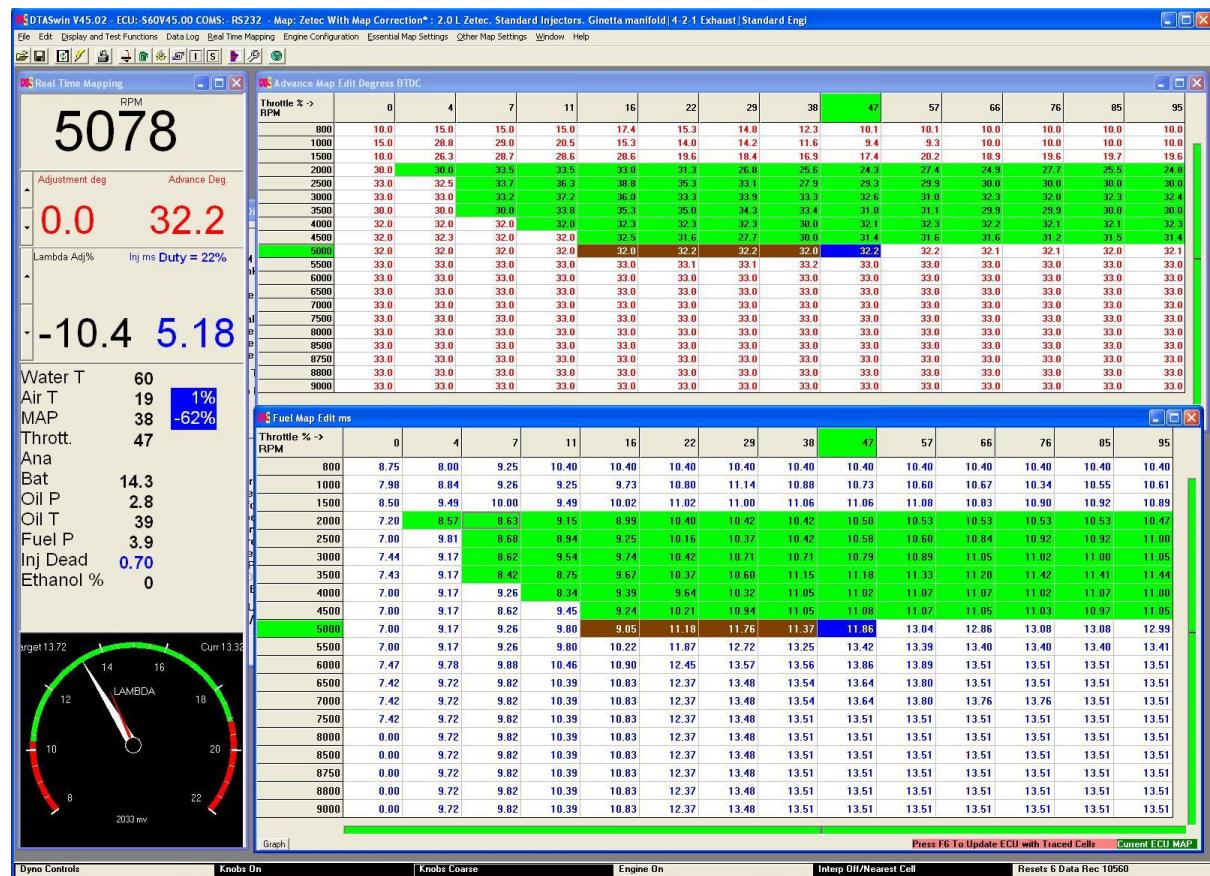


From V55 onwards there is an option to use 3D compensation tables using full 20 x 14 maps. These are selected from the Manifold Pressure Compensation Parameters table. The original single table can be used as above or twin tables for fuel and advance compensation. The X axis for these is individual settable according to user choice as throttle or MAP.

If you do not understand how to set these tables, do not use them.

# REAL TIME MAPPING

Windows menu:- Real Time Mapping



This section indicates exactly what the system is doing any moment in a graphic display. Values constantly monitor RPM, fuel flow, ignition advance and exhaust gas content (rich or lean) while all other sensors are displayed and warnings can be given if any of these become dangerously high or low. Above is a typical partly finished mapping session. The engine is running closed loop on the Dyno i.e. fuel is constantly being added or removed via feedback from a lambda sensor, ignition is being optimised using a Dyno Calibration Unit and the optimal fuel and ignition values recorded using the enter button on the box. The green squares in the screen shot above have been optimised and sent to the ECU, the brown ones have been optimised but are not yet in the ECU. When the 5000 RPM row has been finished these will be sent to the ECU by pressing F6 before the 5500 RPM row is commenced. The triangular shape to the finished pattern of green squares is typical of what can be achieved on the Dyno, you cannot do 9000 RPM with zero throttle!

The **Dyno Calibration Unit** is a small box connected to the ECU which allows the user to modify the ignition and advance settings remotely whilst the engine is running. There are two knobs and three buttons on this box. The two knobs will vary the calculated ignition advance and fuel pulse length from the standard map by + or - 50% on fuel and 25 degrees on advance and 10% on fuel and 6.5 degrees on advance in course or fine settings respectively.

## OTHER USES OF THE DYN-BOX KNOBS

The left knob of the dyno box can be used for the following functions other than fuel %.

- 1) Adjust the cam advance target position, both cam1 and cam2 (e.g. inlet and exhaust on a twin VANOS engine).
- 2) Injection angle.
- 3) Turbo PWM percentage for the turbo control system.

These alternate uses can be accessed through the menu *Real Time Mapping/Control Box Controls*.



### **Dyno Control Box**

The three buttons perform the same functions as the stop key, the enter key and the knobs on/off key as described below. All are clearly marked.

The bottom line of the screen gives the current status of the calibration box controls.

Dyno mode was designed to make tuning the engine on a dynamometer as simple and fast as possible (see below for hints on methods of use).

### **CONTROL KEYS IN REAL TIME MAPPING OR USE PULL DOWN MENUS**

^A	DISPLAY ADVANCE MAP
^F	DISPLAY FUEL MAP
^P	TURN ON OR OFF CONTROL KNOBS ON CALIBRATION UNIT
^C	CHANGE CONTROL KNOBS TO COURSE OR FINE
^K	STOP THE ENGINE !
^T	CLEAR THE MODIFIED (TRACED) CELL LIST
^I	TURN ON/OFF INTERPOLATION
^M	TURN ON/OFF MAP TRAILS
^N	CLEAR MAP TRAILS
^L	TURN ON/OFF CLOSED LOOP CONTROL OF FUEL
^O	TURN ON/OFF SET INJECTOR OPENING POINT
^S	SET TARGET MIXTURE FOR CONTROL LOOP ON/OFF
^U OR F6	UPDATE THE ENGINE MAP WITH TRACED CELLS
^E	STORE CURRENT SETTINGS TO LOG (TRACE) MAP CELL OR press Enter on the Dyno Box.

### **SUGGESTED USE OF REAL TIME MAPPING**

- 1 Press "^\|", use the drop down menu or click on the "Interp On" box along the bottom edge of the screen, to turn off the map interpolation and work to the nearest cell. Fire up the engine and set the dyno rpm to the rpm of interest.
- 2 With either the advance map or the fuel map or both showing as above and you will see the current cell position highlighted in black. Run the engine hard against the brake and adjust the knobs to give maximum power. When the fuel or advance map is displayed along the bottom and right hand edge of the map is a visual indication of the position within the cell. Always set the throttle position (or manifold pressure if using MAP as load) and rpm such that the small black markers line up with map grid lines. When the engine is within the predefined limits of closeness to the cell edges the row and column markers will go green (you can alter these limits in *Real Time Mapping/Display Options/Change Warning and Mapping Limits*). This will result in much more accurate maps. Press the enter key on the control box when you are happy power is optimised. The cell which has just been traced (marked) will be highlighted in brown (or blue if this happens to be the current active cell). If very little adjustment has been

used to achieve maximum power, then continue for other cells you wish to trace. If a lot of adjustment has been used, you can make adjustments to the rest of the maps before continuing with the manual editing tools provided in *Edit*.

## CLOSED LOOP CONTROL

All systems are equipped for closed loop control of the fuelling. This uses the output from a lambda sensor (or preferably a DTA wideband or NGK UEGO sensor or similar) together with the values set in menu Lambda Controls to control the fuelling automatically. Sample values for these settings are given in this manual in the description of the lambda settings section.

Pressing "<sup>A</sup>L" will turn on the closed loop control and attempt to adjust the fuelling until the measured mixture is the same as the target mixture requested. This will result in a change to the screen display. The knob adjustment percentage displayed in the bottom left of the screen will change to black and the title will be highlighted as "lambda adjust %". This is the figure by which the system is adjusting the fuelling to keep to the target mixture requested. To adjust the required target mixture either change the value directly in Lambda Settings or press "<sup>A</sup>S". This will change the fuel pulse display on the left of the screen to the required target mixture. This is adjustable on the left hand knob on the dyno calibration unit. Be careful when starting to adjust the target mixture as the knob becomes active the instant "S" is pressed. If the knob is at one of its extremes then violent changes will be made to the fuelling virtually instantaneously.

When a new cell is selected (i.e. the rpm changes or the throttle position is changed) then the fuelling will adjust quickly to the new value. When this has settled to a stable figure then press <sup>A</sup>E as normal to trace the cell and record the value as normal. Before leaving the cell press "<sup>A</sup>U" which will update the engine map and zero the advance adjustment. The fuelling adjustment controlled by the lambda sensor should now go to zero. NOTE even on a cell that has been previously set the lambda sensor system will continue to make small adjustments to the fuelling. This is normal and is caused by small fluctuations in fuel pressure ,air temperature etc. This is the reason that road cars use systems permanently controlled by a lambda sensor.

The most likely source of problems when using this feature is that the mixture adjustment varies wildly with major positive and negative adjustments of the fuelling adjustment. This is caused by either the lambda sensor being too slow for the required loop frequency of the other settings for the lambda sensor being incorrect. Stop the engine immediately and adjust the settings in Lambda Settings.

## GENERAL ENGINE SETTINGS & GENERAL SETTINGS 2

*Windows menu:- Engine Configuration/General Engine Settings*

This option contains various general engine settings as listed below. These must be set to suit the engine you are working with.

### ULTIMATE RPM LIMIT

The engine will not go through this limit no matter what the conditions i.e. off load and full throttle. It is ,however ,fairly brutal in operation and should be set slightly higher than the normal rpm limit below.

### NORMAL RPM LIMIT

This limit introduces a cut on each cylinder in rotation which would be enough to constrain rpm rise in a driving situation. It has a fairly soft action and does not upset the car. Normally set to 250 rpm below the ultimate limit.

### GEAR CHANGE LIGHT RPM

The rpm figure at which the change light switches on. Normally set to 250 to 500 rpm below the normal rpm limit.

### NUMBER OF CYLINDERS

The number of cylinders the engine has. Allowed figures are 4,6 or 8. NOTE The model of management box has to be able to support the number of cylinders.

### NUMBER OF INJECTORS PER CYLINDER

(NOTE:- From Firmware Version 50 See "Using Twin Injectors")

The number of injectors per cylinder. Allowed figures 1 or 2.

NOTE The model of management box has to be able to support the number injectors.

### SWITCH INJECTORS AT RPM

Above this RPM injectors 2 are used below it injectors 1. If fuel demand is high enough then both are used regardless of this setting.

### AND ABOVE THROTTLE OR MAP

This is used in a twin injector setup. When the throttle is above this value and the rpm is above the rpm switching point then the ECU will use the second set of injectors. Note that if two sets of injectors are needed (decided by duty cycle) then they will be used regardless of this value.

### DEFAULT VALUES ON SENSOR FAILURE

if the system detects a failed sensor, these are the values that the system will assume for these sensors. Make sure that the map values at these points are what you wish the engine to receive.

### NUMBER OF TEETH ON SENSOR WHEEL

### NUMBER OF MISSING TEETH

These two entries need some explanation. The usual Ford crankshaft timing wheel has 35 actual teeth. It is a 36 tooth wheel with one tooth missing. Similarly a Vauxhall or Peugeot wheel is 58 teeth, this being a sixty tooth wheel with 2 teeth missing. The figures for these two items are entered as below;

FORD number of teeth on wheel 36 number of missing teeth 1

VAUXHALL number of teeth on wheel 60 number of missing teeth 2

Other similar wheels must be entered in the same fashion.



### **36 – 1 Sensor Wheel and Sensor**

#### **GAP TOOTH FACTOR**

The missing teeth are detected by the time difference from the previous tooth. The gap tooth factor determines how much bigger the missing tooth time is before it is recognised as a missing tooth. This can be determined by cranking the engine and using the crankshaft oscilloscope. Clicking on the missing tooth in the oscilloscope display will tell you how much longer the missing tooth is than the tooth immediately before it. Standard factors for 1, 2 and 3 missing teeth are as below. Clicking on the “Set to Standard Button” will set to these values automatically. Sometimes it may be beneficial to increase or reduce these.

#### **Missing Teeth /Gap Tooth Factor**

1	1500
2	2000
3	3000

#### **SENSOR POSITION**

Please refer to the hardware installation section to determine this figure. Known figures are as below. For some wheels the crankshaft oscilloscope will tell you where the sensor is.

Vauxhall/Opel 4 cylinder	117 degrees
Ford Zetec	90 degrees
Porsche 6 cylinder	90 degrees
BMW 6 cylinder	90 degrees

All of these need checking with a stroboscope when the engine is running.

#### **FIRING TOOTH ON STARTUP**

This is the position that the engine will fire below “Transition From Cranking” rpm and while on the starter motor. It is measured in teeth before TDC. So for a 36 tooth wheel, which is ten degrees per tooth and this figure set to 1 the engine will start at 10 degrees before TDC. With this set to 2 the engine will fire at 20 degrees BTDC. With a 60 tooth wheel this changes to 6 and 12 degrees respectively. Normally with a racing engine set this to 1. With a road engine then 2 may be acceptable but look for backfiring when attempting to start.

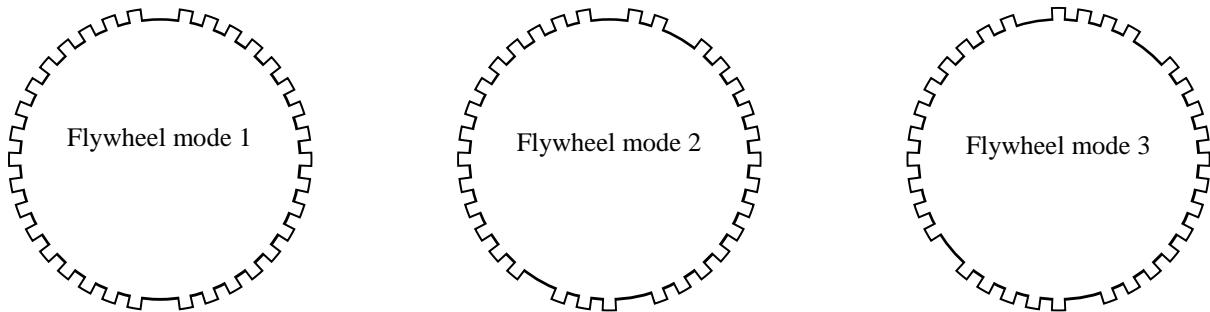
#### **FLYWHEEL MODE**

Different engines can have one of a number of flywheels, and which flywheel an engine is fitted with has an impact on the required programming for the DTA ECU. The list of engines in the drop down list is extensive and increasing and should be self explanatory if you know what engine you are dealing with. All aspects of the original rotating sensors must remain the same.

Flywheel mode 26 is a special mode to cope with the increasing proliferation of engines with multi-tooth cam target wheels. It works with a standard missing tooth crank wheel (say a 36 –

1 or a 60 – 2) and some parameters in *Engine Configuration/Coil Per Plug Settings* to choose the exact cam tooth to use as a synch trigger. See Coil Per Plug Settings for more information.

All of the Rover K series flywheels have trigger teeth set at 10° this means a total of 36 teeth. However a number of these trigger teeth will be missing and which teeth are missing defines the flywheel type. The diagrams below show the three types of flywheel.



**It is important that you check the flywheel configuration on your engine and make sure that the values in the General Engine Settings of your DTA ECU are correct. The following table provides a guideline**

	Mode 1	Mode 2	Mode 3
No of teeth on gearwheel	NOT ALLOWED	36	36
No of missing teeth		1	1
Sensor position		286	349
Distributor fitted		Can be Y or N	Can be Y or N

#### COIL ON TIME

This is the length of time the coil is turned on before firing (also referred to as the dwell time). This allows changes to suit different coils. Most coils require 2000 - 3000 micro seconds so unless you have specific information from the manufacturer of the coil leave this alone.

#### INJECTOR START PULSE

When the engine first starts to turn on the starter motor this pulse is given to the injectors once. It is used to clear air from the fuel system. Use the minimum required to ensure good starting.

#### DISTRIBUTOR FITTED

Set to Y if engine is firing through a distributor N if distributor less

#### INJECTORS IN TWO STROKE MODE

Set two Y if you wish the injectors to fire once per rev rather than once per 4 stroke cycle. Only recommended for two stroke engines. Note that the maximum allowed fuel in the fuel map will be halved.

#### COILS IN TWO STROKE MODE

Set two Y if the engine is a two stroke.

#### ADVANCE COMPENSATIONS IN DEGREES

Advance compensations coming from air temp, water temp, manifold pressure and flexible analogues are by default in the percentage of the current advance figure. This check mark allows these to all be in degrees. Note they are all percentage or all degrees.

#### TRANSITION FROM CRANKING

This is the speed when the engine is recognised as successfully running. Lightweight engines, for example motor bike engines, can "kick back" if this is too low. Once this transition has taken place the engine remains in running mode until the speed drops below 500 rpm when cranking mode is resumed.

#### INJECTOR DEAD TIME

Injectors take time to open and close. Setting this figure takes account of this and allows all the percentage changes that the ECU performs to the fuelling figure to be more accurate. Leave zero for compatibility with old maps. A normal switching figure would be approx. 0.75ms. S series ECU's can also measure the injector dead time themselves, see Display and Test Functions/Measure Injector Dead Time.

#### TWIN SPARK?

S60PRO and above. Only use this when the engine has 2 spark plugs per cylinder. First spark plug coil outputs coil 1 to coil (number of cylinders), second plug outputs are coil

(number of cylinders) to coil (number of cylinders x 2), that is cylinder 1 first plug is on coil output 1, second spark plug on cylinder 1 is coil output (number of cylinders + 1).

This ability to run twin spark mode can be very useful for an engine which has individual coils but no cam sensor. Wire the coils as you would for running them with a cam sensor fitted and select twin spark on.

#### TWIN SPARK OFFSET

S60PRO and above. Allows small delay (in degrees) between 2 sparks on the same cylinder. If 0 then both sparks are at the same time. If 10 then the second spark occurs ten degrees later. Note that all advance figures relate to the first spark.

#### USE ADVANCE MAP2 FOR TWIN SPARK OFFSET

Allows the Map2 advance map to be used to calculate the twin spark offset. Allows complete variability over the 20 x 14 map. Map2 advance map is in Other Map Settings/ALS Parameters / Map2.

#### TACHO PULSES PER REV

Number of tacho pulses per rev, normally two for a four cylinder tacho, four for an eight cylinder.

#### USE 3/5 CYLINDER TACHO PATTERN

Emulates the cycle based tacho pattern of a 3 or 5 cylinder engine i.e. 1 ½ or 2 ½ pulses per revolution.

#### EXTERNAL COIL AMPLIFIERS

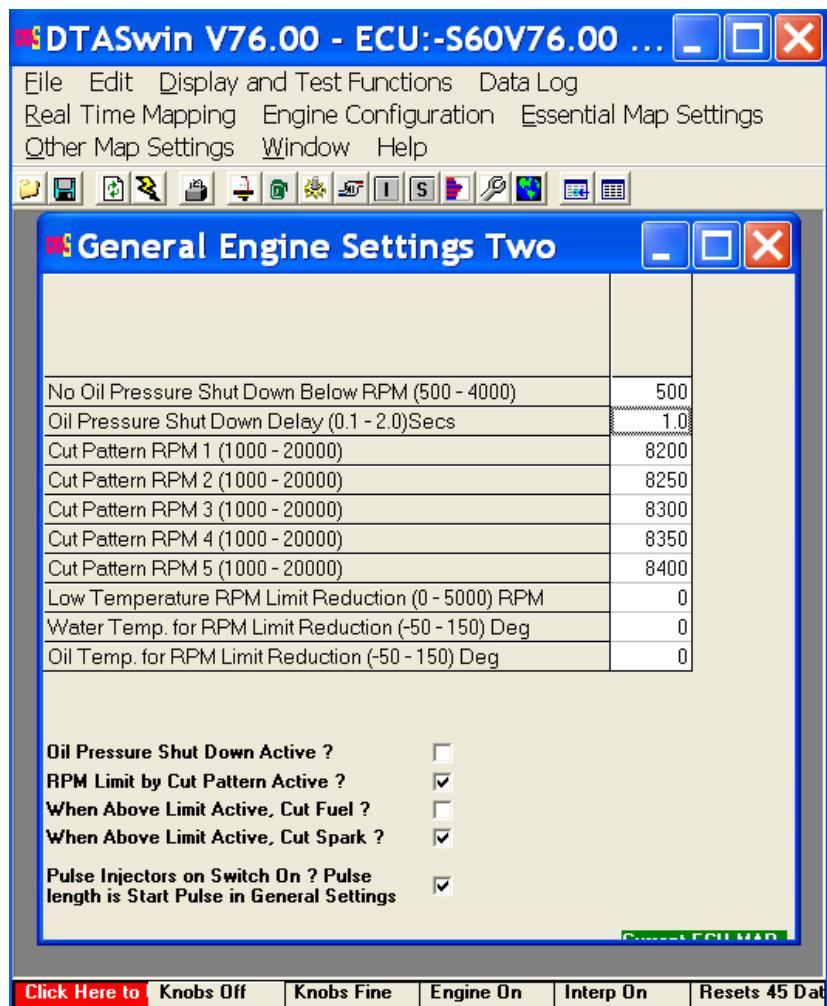
Select this check box if you are using external coil amplifiers. Normally the coil signal is inverted for external amplifiers and this function does this. Certain amplifiers need a "pull up" resistor between 12 volts and the ECU coil output. A 1K Ohm resistor is fitted internally in the ECU. Others have them fitted internally. If in doubt consult the coil manufacturer.

Do not check this box if you have an un-amplified coil connected to the system. Severe damage may result to the ECU.

#### INJECTOR CC/MIN

Used for fuel consumption calculations.

## GENERAL ENGINE SETTINGS TWO



### OIL PRESSURE SHUT DOWN SYSTEM

Linked to the oil pressure warning system in *Engine Configuration/Sensor Scaling/Oil Pressure Warnings*. Set the pressure you want the engine to shut down at in sensor scaling.

### OIL PRESSURE SHUT DOWN ACTIVE?

Turns on the oil pressure shut down system. Note this will be “greyed out” unless oil pressure warnings are turned on.

### NO OIL PRESSURE SHUTDOWN BELOW RPM

No shut down will occur below this RPM even if a warning is activated.

### OIL PRESSURE SHUT DOWN DELAY

An oil pressure warning must have been active for this length of time before a shut down is tripped. Once a shut down is tripped the shift light will continue flashing and the engine will not start until the ECU is turned off and back on again.

### CUT PATTERN RPM TABLE

Linked to *Essential Map Settings/Spark and Fuel Cut Patterns*

Implements a flexible cut pattern determined by the user at the specified RPM. There are 5 table entries and the RPM of each must increase from top to bottom of the table as in the example above.

Note the “Normal RPM Limit” in General Engine Settings is disabled but the “Ultimate RPM Limit” is still active.

### RPM LIMIT BY CUT PATTERN ACTIVE ?

Turns on the cut pattern system

### WHEN ABOVE LIMIT ACTIVE, CUT FUEL (SPARK) ?

Allows just fuel, just spark or both to be cut using the cut pattern.

### LOW TEMPERATURE RPM LIMIT REDUCTION

Allows RPM limit to be reduced when water and/or oil temperature is low. Leave zero if no reduction required.

### WATER TEMP FOR RPM LIMIT REDUCTION

#### OIL TEMP FOR RPM LIMIT REDUCTION

Below these temperatures of oil or water then the RPM limit will be reduced by the above figure. Set to -50C if no action is required on one of them but is required on the other.

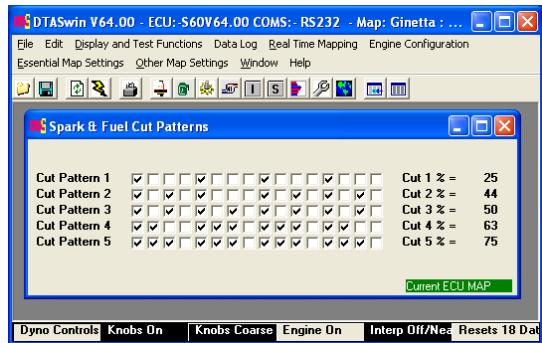
#### PULSE INJECTORS ON SWITCH ON

The injectors will pulse on ECU switch on or reset when this checkmark is active. The duration of the pulse is the "Injector Start Pulse" in General Engine Settings.

# SPARK AND FUEL CUT PATTERNS

## Essential Map Settings/Spark & Fuel Cut Patterns

These are sets of 16 check mark tables to allow a flexible way of cutting a random pattern of spark or injection events. Note this may or may not happen at the same frequency depending on the configuration of the spark/fuel system i.e. injectors in two stroke mode and sparks in four.



If a check mark is present then that event is skipped. A complete set of check marks eliminates sparking or fuelling completely. The cut pattern is linked to RPM to act as an RPM limiter via *Engine Configuration/General Engine Settings Two*. The percentage of cut a set of check marks represents is calculated and displayed on screen.

## **STORE MAP ON DISC**

*Windows menu:- File/Save or Floppy Disc Icon on Tool Bar*

Store map on disc (saving a map and giving it a file name). This enables you to keep an engine map on your pc's hard disc. The default directory for maps is:-

C:\DTASwin\maps

You can of course use any directory you wish. The file name can be any Windows legal filename up to 30 characters in length. An extension .map will automatically be added.

On saving the file up to 200 characters of useful comment information can be added.

## RECOVER MAP FROM DISC

*Windows menu:- File/Open or Folder Icon on Tool Bar*

*Windows:- Normally maps are stored in C:/DTASwin/Maps*

This section will recover from disc previously saved engine maps. First you will be offered a default path as below

c:\DTASwin\maps

The list of available engine maps will then be displayed on the screen. The current chosen map is highlighted.

The comment for that map is displayed in the right hand panel. Clicking on any map in the available list will display its comment.

# DIAGNOSTICS DISPLAY

Windows menu:- *Display and Test Functions/Diagnostic Display*

## ENGINE STATISTICS

Largely self explanatory but:-

Crank Rotation time is the time for one revolution of the engine.

## LOWEST AND HIGHEST

Self explanatory

## CRANK SENSOR ERRORS

Rejected crank pulses are signals received from the crank shaft sensor that the system has decided cannot possibly be correct. Either they represent over 20000 rpm, are from electrical interference (from the HT leads for example) or you have an eccentric crank wheel or loose or damaged crank sensor.

## SYNC ERRORS

Because the system knows how many teeth you have on your crank wheel, it counts them every time the engine rotates. If the count is not correct then a sync error results. It is always possible to get these when the engine first rotates on the starter motor, this is not a problem. If this number moves upwards when the engine is running at over 1000 rpm then you have a problem. Possible causes are as above or just entering the wrong wheel specification will give you this problem.

Sync crank ratio error similar to above.

## Cam Sensor errors

Only important when running unequal firing or coil on plug or sequential. Checks that the correct number of crank to camshaft pulses are received.

NOTE THAT ANY SMALL FIGURES IN ANY OF THESE ARE UNIMPORTANT. IF YOU HAVE A PROBLEM THEY WILL RAPIDLY REACH HUNDREDS WHEN THE ENGINE IS RUNNING.

## Synthetic Tooth Errors and Re-Synchronisations

These are manifestations of a combination of the above errors. Missing teeth are reconstructed by the ECU to ensure correct timing. These are called synthetic teeth. Errors during this process are recorded here.

## STARTING INFORMATION

When the engine is stopped the message "Engine Not Turning" is displayed at the bottom of this box in PINK. If the engine is turning you have some problem with your crank sensor or wiring.

When the engine starts to crank the message "Turning – Attempting to Synchronise" appears in RED. The ECU is attempting to reconcile the information you have given it in General Engine Settings about the crank wheel to measure both the speed and position of the engine.

When synchronisation is achieved this box displays the message "Synchronised – Attempting to Start" in GREEN. If this message is not displayed the engine will not start and there will be NO injection or spark. This implies a problem with your settings, crank or cam sensor. Read the chapter on the crank shaft oscilloscope to try to resolve the issue.

If the message "Synchronised – Attempting to Start" is displayed and the engine will not start it is simply a fuel or timing issue, a problem with your coils or injectors or the unit is incorrectly wired.

## CURRENT SENSORS AND SHORT TERM ERRORS

OK and failed are the current status of the sensor. The number to the left of this is the number of transient errors the system has seen when the engine is running. A missing sensor (say Pressure) will always show as failed.

SXX VXX.XX Technical

Internal information used by DTA.

## INFORMATION

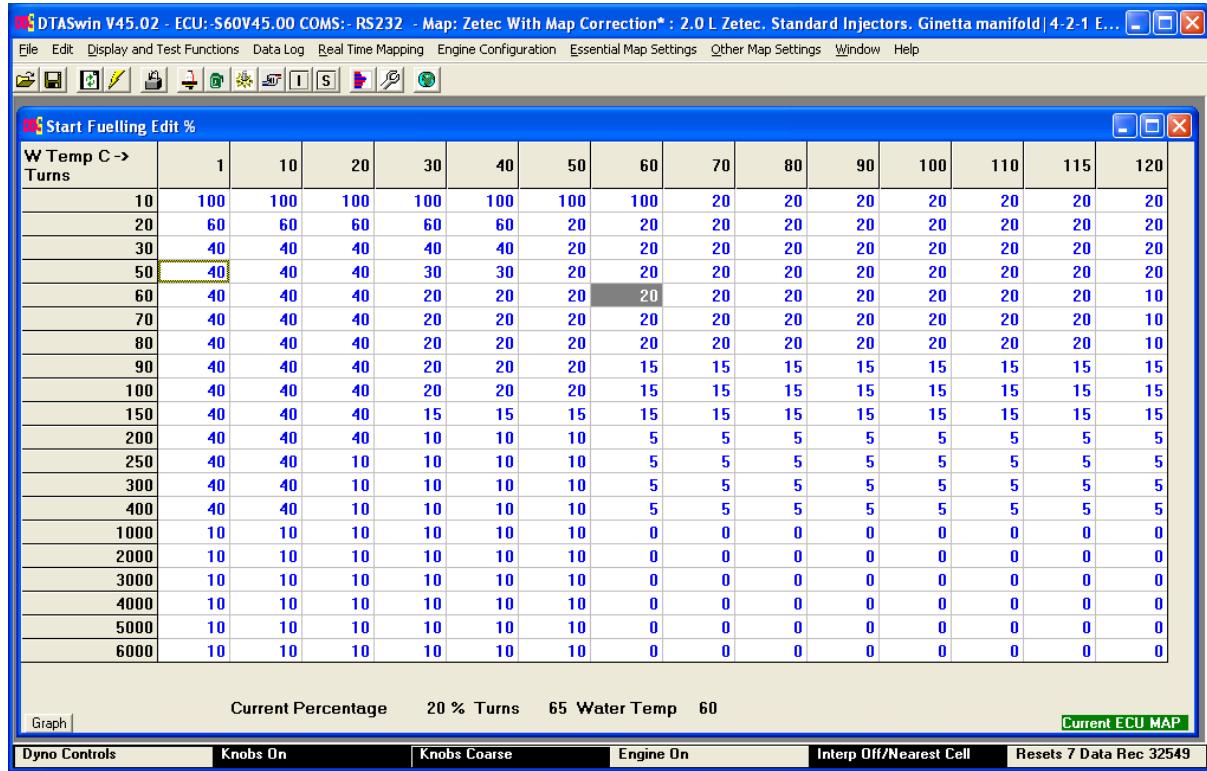
These should explain themselves. Cam sensor position is measured for the user's convenience. Note that the ECU cannot know on which half of the four stroke cycle this occurs on.

## START FUELLED MAP

Windows menu:- Essential Map Settings/Start Fuelling Map

Windows menu:- Essential Map Settings/Start Map Turns

Windows menu:- Essential Map Settings/Start Map Temps



This adds fuel on engine start whilst the walls of the throttle bodies and manifolds need to build up a puddle of fuel. It is added as a % of the main map. Above is a set of figures that has worked very well on one of our test engines. Note that this map can extend out to 10,000 engine turns. At a standard 1000 RPM idle speed then this lasts for 10 minutes. We find that whatever the starting temperature of the engine 10 minutes is the maximum an engine will need additional fuelling.

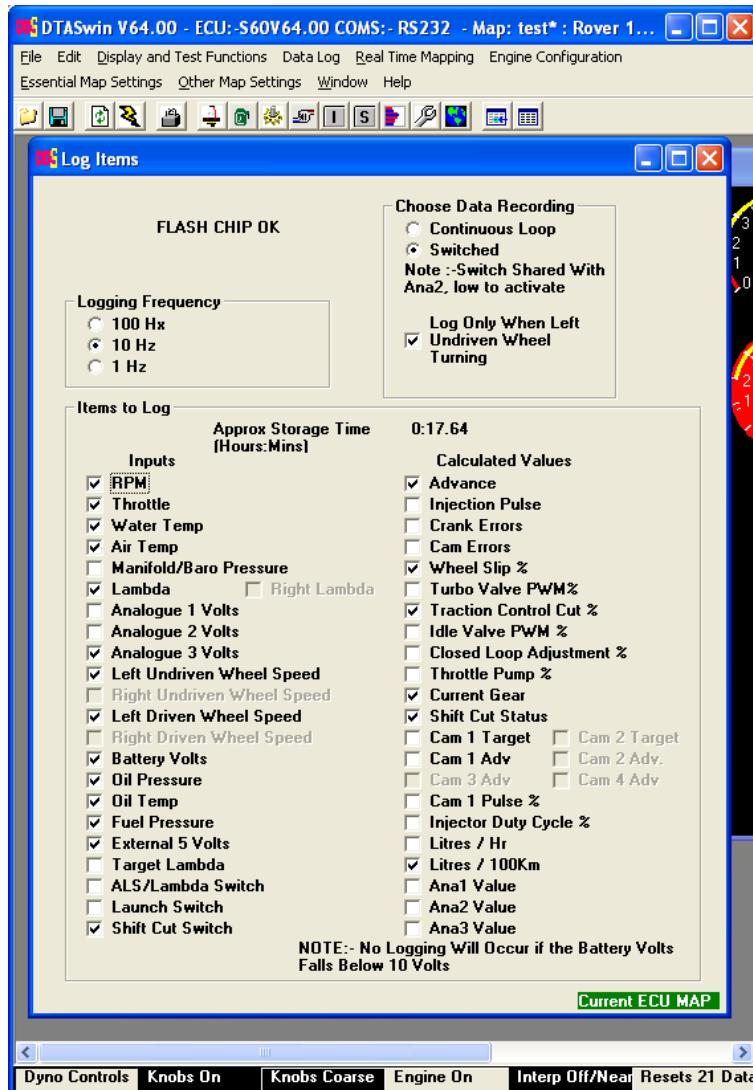
The current percentage, turns and water temp are shown across the bottom of the map.

The fuel is added until either the number of turns specified is exhausted or a 0 is found in the map.

On completion press F4 to save the data.

# DATA LOGGING MENU

Windows menu:-Display and Test Functions/Logging options



With the Continuous Loop button selected the oldest data in the log is continuously discarded and replaced with new data. When data is displayed or filed then the first data you see is the newest data, the oldest is at the end. Data is recorded all the time the engine is running.

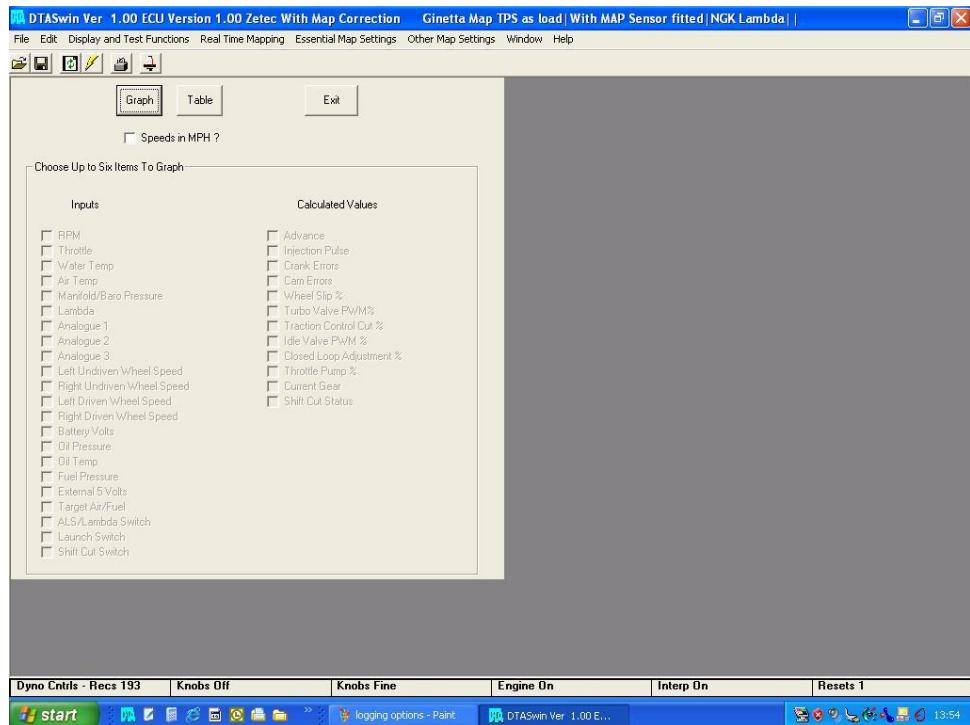
With the Switched button selected data is only recorded when the switch is at 0 volts and the engine is running. When the log is full new data is discarded. When displayed or filed the first data is the oldest data. The last data is the newest.

**NOTE:-** The switched input is shared with the Analogue 2 input.

Only record when vehicle moving button requires a wheel speed sensor of the left undriven wheel and launch control enabled (but not necessarily switched on).

The fast logging option limits the number of recordable items to 7 and the recording time is reduced by 10 times, but it is extremely useful when looking at things like throttle transients and shift cut settings.

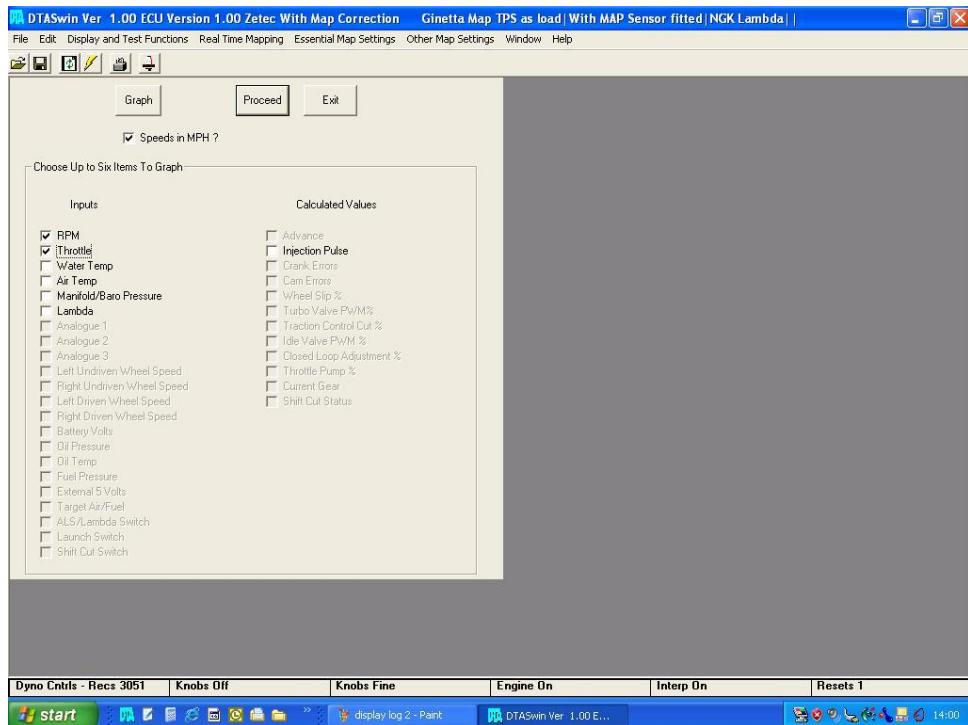
## DISPLAYING THE LOG



Pressing the table option will show all logged items down the screen as below.

SESSION TIME	RFPM	THROT	WATER	AIR	MAP	LAMB	INJ
1 0:0.00	9593	40	66	21	101	0.999	13.61
1 0:0.10	8680	40	66	21	101	0.999	13.61
1 0:0.20	9155	40	66	21	101	0.999	13.61
1 0:0.30	9469	40	67	22	101	0.999	13.61
1 0:0.40	9164	40	67	21	101	0.999	13.61
1 0:0.50	7938	40	66	21	101	0.999	13.61
1 0:0.60	7018	41	66	21	101	0.999	13.62
1 0:0.70	7059	40	66	21	101	0.999	13.61
1 0:0.80	7312	40	66	21	101	0.999	13.61
1 0:0.90	7716	40	66	21	101	0.999	13.61
1 0:1.00	8333	40	67	21	101	0.999	13.61
1 0:1.10	9164	40	66	21	101	0.999	13.61
1 0:1.20	10157	37	67	21	101	0.999	13.59
1 0:1.30	5106	30	66	21	101	0.999	13.54
1 0:1.40	5106	23	66	21	101	0.999	12.94
1 0:1.50	5106	23	67	21	101	0.999	12.63
1 0:1.60	5557	26	67	21	101	0.999	13.09
1 0:1.70	9806	28	66	21	101	0.999	13.39
1 0:1.80	8415	32	66	21	101	0.999	13.55
1 0:1.90	7244	38	66	21	101	1.000	13.59
1 0:2.00	6266	44	66	21	101	0.999	13.65
1 0:2.10	8553	51	66	21	101	0.999	13.75
1 0:2.20	5312	53	67	21	101	0.999	13.78
1 0:2.30	5780	52	66	22	101	0.999	13.76
1 0:2.40	6510	47	66	21	101	0.999	13.69
1 0:2.50	7864	40	66	21	101	0.999	13.61
1 0:2.60	9057	34	66	21	101	0.999	13.56
1 0:2.70	6009	30	67	21	101	0.999	13.54
1 0:2.80	6009	29	66	21	101	0.999	13.54
1 0:2.90	6009	25	66	21	101	0.999	13.54
1 0:3.00	5341	33	67	21	101	0.999	13.55
1 0:3.10	5796	38	66	21	101	0.999	13.59
1 0:3.20	8778	46	67	21	101	0.999	13.67
1 0:3.30	7440	49	66	21	102	1.000	13.85
1 0:3.40	6412	51	67	21	101	0.999	13.75
1 0:3.50	5712	50	66	21	101	0.999	13.73
1 0:3.60	5706	45	66	21	101	0.999	13.66
1 0:3.70	6127	39	66	21	102	0.999	13.73
1 0:3.80	6657	34	67	21	101	0.999	13.96
1 0:3.90	7446	30	67	21	101	0.999	13.94

Pressing Graph will allow you to choose up to 6 items from the recorded data and display it.



Pressing Proceed gives the following display. Note only two items were checked above from the available items.



## SAVE LOG DATA

Saves the logged data to a file in a semi colon delimited text file for import into either Excel or our own ERACE analysis program available from [www.dtafast.co.uk](http://www.dtafast.co.uk) free of charge.

## CLEAR LOG

Zeros the log.

## SET THROTTLE STOPS

Windows menu:- Engine Configuration/Set Throttle Stops

Set throttle stops; locates the precise open and shut points of the throttle or slide mechanism to enable the programme to sense accurately, and match the amount of opening to the 14 columns on ignition, fuel and other tables.

### TO SET

- a) First make sure the throttles are completely closed, then press the OK button.
- b) Open throttle to maximum and again press the OK button.

If the values are correct then answer Y when asked to confirm ,if you answer N then start again from a).

**NOTE** There are limits on throttle values available for use. The closed (idle) position must be higher than 50 (we recommend about 100) as lower values are used by the system to recognise that the throttle potentiometer (sensor) has failed. Similarly values above 1000 denote a failed sensor.

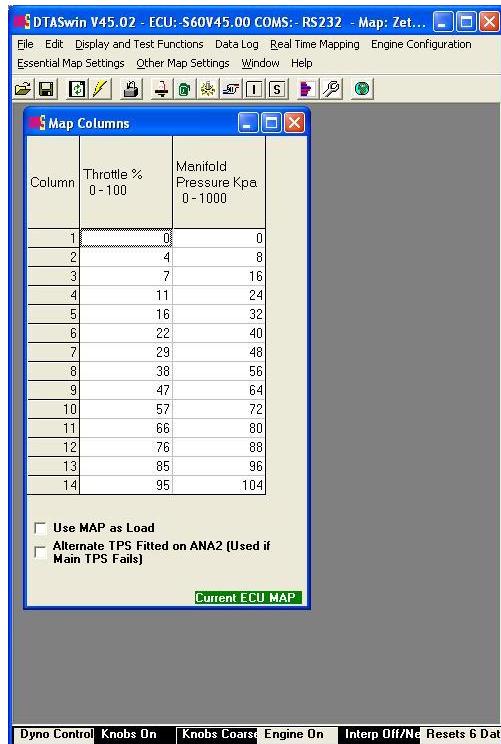
If two TPS sensors are fitted then this also needs setting the same way. When using a DTA fly by wire controller the end points of the sensor on the pedal will need setting as well.

### REVERSE TPS MOVEMENT

If the TPS is incorrectly connected, that is 5V and Ground are the wrong way round, then the correct approach is to correct the wiring. In situations where this cannot be done such as when using an OEM sensor then this checkmark will reverse the operation in software.

## MAIN MAP COLUMNS

Windows menu:- Engine Configuration/Main Map Columns



Because the response of a butterfly or slide system is inherently non-linear this option is included to match the movement across the map when the accelerator is pressed to the amount of air entering the engine. The default map includes a set of points which will work well in most situations. If, however, you find after testing on the dyno that a portion of the fuel map becomes very steep across the map, that is an indication that the column positions need closing up at that point.

To change use the cursor to get to the figure of interest and change as required. NOTE the figures must increase from top to bottom of the screen.

Similarly there is a scale based on MAP for those people who prefer to map with pressure as load.

### USE MAP AS LOAD

The check box allows the use of a manifold pressure sensor as the main load indicator, instead of throttle. This will apply throughout the system when checked. The scale will need to be rewritten to match whichever source is selected as load.

### ALTERNATE TPS FITTED

Used when two TPS's are required, one for backup. Note the end points of this require setting in Set Throttle Stops if this feature is used.

Save the changes by pressing F4 when complete.

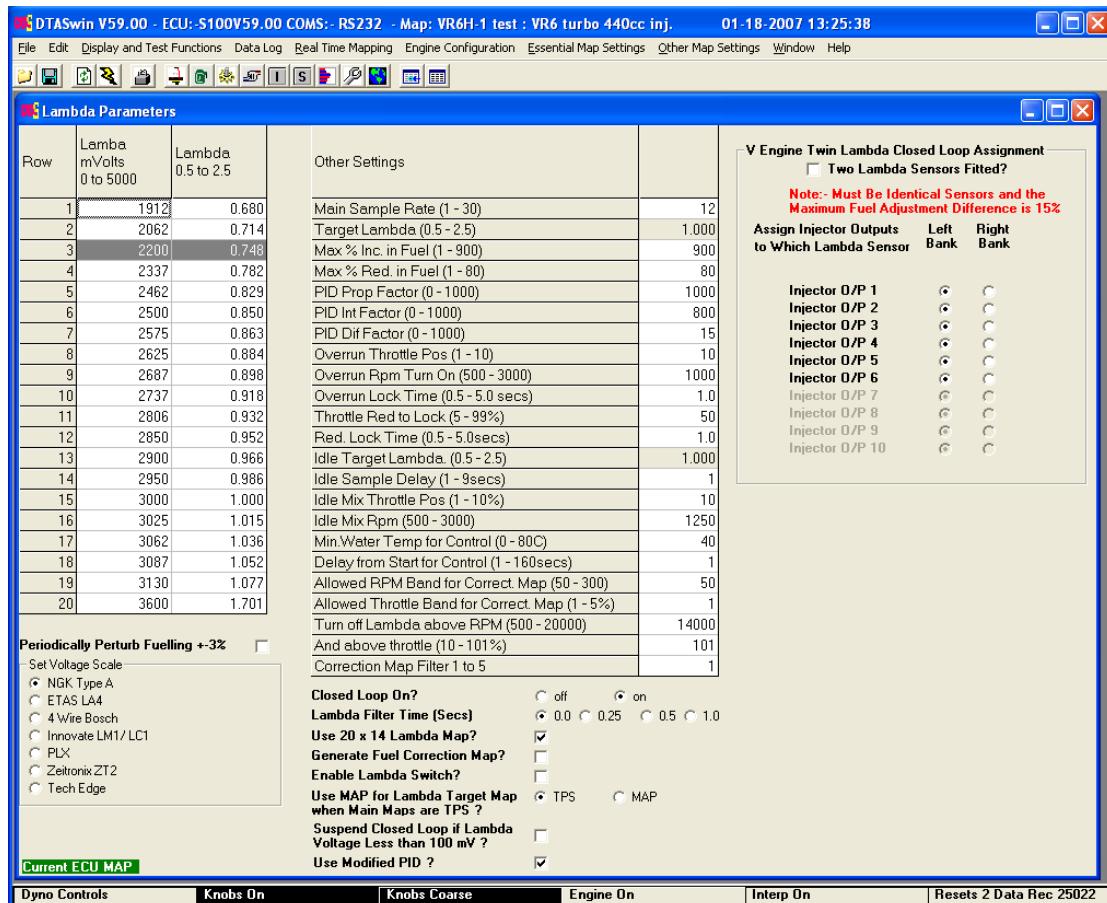
## **MAP LOCKING**

*Windows menu:- File/Map Locking or The Padlock on the Tool Bar*

Map Locking is just a way to ensure that no corruption of the map takes place when the vehicle is running without a PC attached. You can lock and unlock the map at will.

# LAMBDA SETTINGS

Windows menu:- Other Map Settings/Lambda Settings



This section is probably the most difficult for us to explain to you because most of the settings you need to adjust have nothing whatever to do with engines as such.

The settings vary greatly between a Lambda sensor and a wide band kit. Sample voltages for each unit can be set by buttons in the software. We advise that for serious work on the Dyno that better results are achieved using a DTA wideband sensor than a standard Lambda. These sensors are a much more linear device in the area of Lambda 0.7 to 2.0 i.e. the area where you will be running race engines for maximum power. Single cell Lambda sensors are essentially uncalibrated in this region and the results can vary greatly from one sensor to another. At the very least use a heated Lambda sensor for best results especially at low engine speeds and light throttle positions where the exhaust gas temperature can be very low.

## PID LOOPS

A brief explanation of how a PID loop works can be found towards the rear of this manual.

## 1 LAMBDA VOLTS/LAMBDA VALUE

This is a set of 20 values which equate the voltage seen from the lambda sensor with the Lambda value this represents. Lambda is the normalised air fuel ratio and a value of Lambda = 1 is the stoichiometric point (i.e. the fuel air mix has the optimum amount of oxygen to support complete combustion). On petrol/gasoline this equates to an air fuel ratio of about 14.7. The advantage of using Lambda as against a/f is that it is independent of the fuel used, that is Lambda 1 is Lambda 1 whether the fuel is for example petrol or methanol.

## 2 PERIODICALLY PERTURB FUELLED +/- 3%

This is a feature for use only on the Dyno. Fuelling will be adjusted up and down 10% with a two second period. Using fast logging this feature enables you to measure the response time of your engine/exhaust/Lambda sensor combination for accurate setting of the PID loop timings.

## 3 SAMPLE RATE

This is the frequency at which the sensor is checked to measure the air/fuel mixture when the engine is running hard. This is set at 1 times per second on the sample settings. This is fast enough to provide adequate setting speed on the dyno and is about as fast as a standard lambda sensor will respond. If when the closed loop is active the fuelling adjustment figure on the dyno display oscillates positive and negative wildly then set this figure lower. If the oscillation stops then you have a very slow sensor - buy a new one!

## 4 TARGET LAMBDA MIXTURE

This is the mixture at which the fuelling will be adjusted to when the engine is running hard if not using the 20 x 14 target Lambda map..

## 5 MAXIMUM INCREASE IN FUEL

This is the limit on fuelling increase you wish to allow.

## 6 MAXIMUM REDUCTION IN FUEL

This is the limit on the fuelling reduction you wish to allow.

## 7 PID FACTORS

These three values alter the mathematics of the closed loop control. Only adjust the sample figures if you have problems. If the fuelling oscillates as described above and reducing the sample rate does not stop the oscillation then reduce the PID prop factor. If it still oscillates do it again. If the system still oscillates when the PID prop factor has been reduced to 100 then contact us for further advice.

## 8 TURN ON CLOSED LOOP

This setting can be overridden in Real Time Mapping

## 9 OVER RUN SETTINGS

These settings control what happens when the engine goes into an overrun condition. You will have noticed from the visual lambda indication on your dyno that when the engine is on the over run it appears to be very lean until it reaches idle or the throttle is opened again. This is an apparent leanness only and the closed loop should be turned off when this happens or it will try to fuel the engine to remove the leanness which is incorrect.

The overrun throttle position should be set at about 2/3% above the throttle reading at idle. The overrun rpm turn on should be set say 200 rpm above the idle rpm and the overrun lock time to about 1 second. Now when the engine is in an overrun condition the control loop will be turned off until either the rpm has dropped to idle or the throttle is reopened. This lock condition will be displayed on the dyno mode screen display.

## 10 THROTTLE REDUCTION TO LOCK

When the throttle is quickly closed from a wide open condition (but not so much as to cause an engine over run) a similar condition happens to the overrun. This is very much engine dependant and might not happen at all. Leave the settings as per the sample settings and all should be well.

## 11 IDLE SETTINGS

This group of settings allow you to run a different mixture strength at idle than under higher load. Normally you will run the engine leaner at idle and light loads or low speeds.

Idle air/fuel mixture is self explanatory and can either be set here or in dyno mode using the left hand calibration unit knob. This is not used if the 20 x 14 Lambda map is in operation.

Idle sample rate is analogous to the main sample rate but needs to be very much slower. This is because the exhaust sensor does not respond as quickly when the exhaust gas temperature is low. Usually a figure of 1 sample per second is correct.

Idle mixture throttle position/rpm define the point in the map at which the system switches fuelling requirement. Essentially you are creating an "L" shaped area across the top of the map and down the left hand side ,inside which the system will use the idle mixture strength instead of the power mixture strength.

## 12 MINIMUM WATER TEMERATURE FOR CONTROL

Below this water temperature closed loop will not engage

## 13 DELAY AFTER START

The system waits this length of time after every engine start before engaging closed loop.

## 14 ALLOWED RPM BAND FOR CORRECTION MAP

When the system is recording the corrections in the fuel correction table, this band is used to test whether the engine is in or close enough to a particular cell. If outside this band no corrections will be recorded.

## 15 ALLOWED THROTTLE BAND FOR CORRECTION

Same as the above put applied to throttle position

## 16 TURN OFF LAMBDA ABOVE RPM AND THROTTLE

Above this RPM AND Throttle the Lambda correction will be zeroed, effectively turning off the Lambda control and allowing the engine to run solely on the map. When the RPM or the Throttle % drops below this then the Lambda control is turned back on.

## 17 CORRECTION MAP FILTER

The proportion of the current Lambda adjustment that is added to the value stored in the correction map that is being built. This reduces sensitivity to spikes but means that several passes have to be made through any point to build the finished correction amount.

## 18 LAMBDA FILTER TIME

This implements a filter between 0 and one second on the incoming Lambda voltage to smooth out short term transients and cylinder imbalances. Also helps with engines which have combustion instability at idle. Do not use if trying to look at the Lambda sensor using fast logging for transient work.

## 19 USE 20 X 14 LAMBDA MAP

Instead of the two values in this table for target lambda use the 20 x 14 target map.

## 20 GENERATE FUEL CORRECTION MAP

When running closed loop the system constantly generates a percentage correction figure to

the base fuel map. When this feature is turned on the percentages generated are stored in a 20 x 14 table for updating the main fuel map when the engine is stopped.

21    **ENABLE LAMBDA SWITCH**

Allows the ALS/MAP2/Lambda switch to turn lambda control on and off.

22    **USE MAP FOR LAMBDA TARGET MAP**

When running a turbo engine with TPS as load and manifold pressure corrections it may still be advantageous to run the lambda target as a function of manifold pressure. This option allows that. The main 20 x 14 lambda target map uses manifold pressure to determine the horizontal position in the map.

23    **TURN OFF CLOSED LOOP BELOW 100 mV**

Allows low voltage to be used to detect that the lambda has failed or not been switched on.

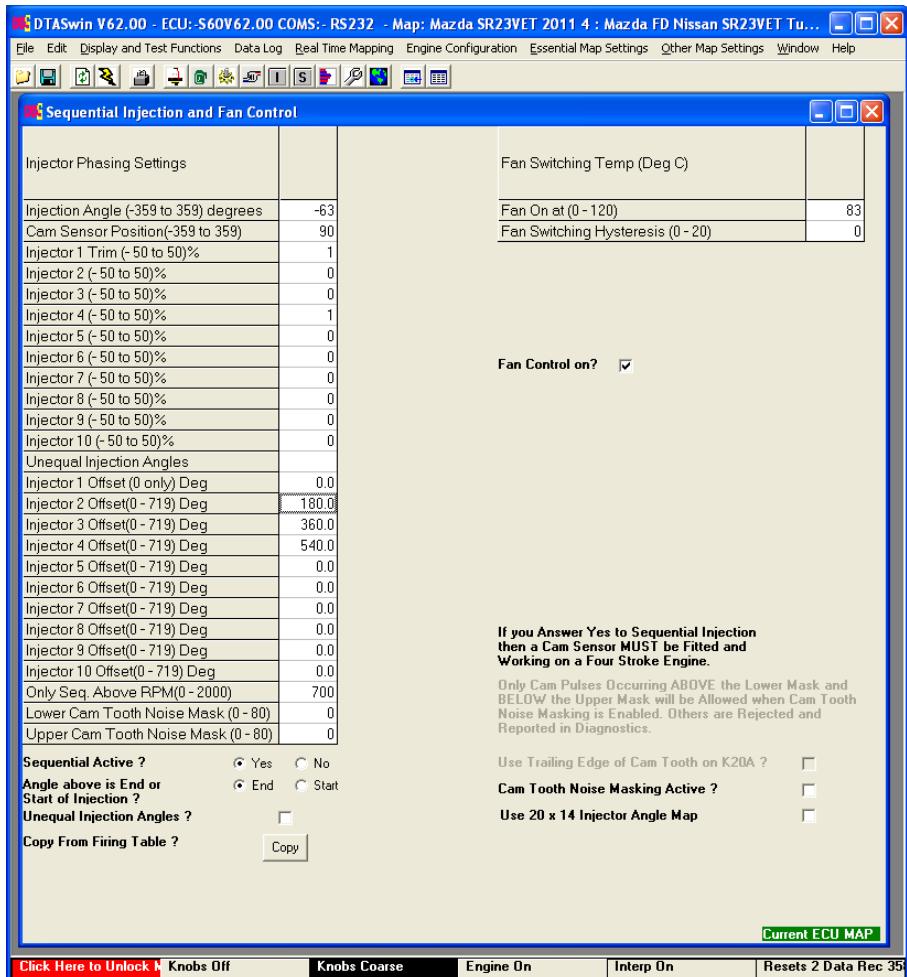
24    **USE MODIFIED PID**

Modifies the classic PID loop described at the end of this manual to give possibly a more stable control loop on some engines.

**PLEASE NOTE THAT WHEN FIRST USING CLOSED LOOP CONTROL SET THE MAXIMUM AND MINIMUM FUELLED LIMITS LOW TO CHECK THAT THE SYSTEM IS WORKING CORRECTLY.**

# SEQUENTIAL INJECTION AND FAN CONTROL

Windows menu:- Engine Configuration/Sequential Injection and Fan Control



This section allows the setting of the values for injector phasing on sequential systems only. All angular values are referenced to TDC number 1 cylinder **firing stroke**.

## 1 INJECTION ANGLE

**The point at which the injector starts to open (or closes if the option below is taken).** i.e. if you want the injectors to open 90 degrees before TDC firing stroke then enter - 90. If you want them to open 90 degrees after TDC firing stroke then enter 90.

## 2 CAMSHAFT SENSOR POSITION

The position at which the camshaft sensor switches. The ECU will measure this position for you when sequential operation is active and it is displayed in Display and Test Functions/Diagnostic Display in the information panel. Note the ECU can only determine its position within one engine rotation, not one 4 stroke cycle.

## 3 INJECTOR TRIM

This allows the amount of fuel to be allocated to each individual cylinder to be varied + or - 50% from the map value. You can use this to correct for mechanical differences in the inlet tract. Normally they should all be zero. N.B. they are listed in the order the injectors fire, not the cylinder order. If the firing order of the engine is 1342 and you want +10% fuel on cylinder number 3 then the second entry box down should be set to 10.

## 4 SEQUENTIAL ACTIVE

Self explanatory but note that a cam shaft sensor must be fitted and the wiring correctly implemented but it will work.

## 5 UNEQUAL INJECTION ANGLES

If you have an unequal firing engine this will normally be the same as the unequal firing table and can be copied from there using the button provided. In rare circumstances such as the BMC "A" series engine then you will need unequal injection but equal firing.

## 6 ONLY SEQUENTIAL ABOVE RPM

Some, usually inductive, cam sensors do not give an adequate signal at cranking for the ECU to see it. Setting this value at about 1000 rpm will usually allow the engine to start in grouped mode and then switch as soon as the sensor can be seen. The engine stays in sequential mode until it stops.

## 7 LOWER AND UPPER CAM TOOTH NOISE MASK

Only applicable to engines with a single tooth cam target wheel. This allows a cam pulse to be accepted only in a specific crank tooth window. When running the engine the crank tooth of the cam pulse is reported in diagnostic display. Choosing the mask either side of this reported number allows electrical interference from the spark wires to be masked out as long as they are not coincident with the cam signal itself. The check mark "Cam tooth Noise Masking" enables this feature. Note the limits are twice the number of crank teeth.

## 8 END OR START

Either the beginning or the end of the injection pulse can be fixed in degrees. Normally end is the best.

## 9 USE TRAILING EDGE OF CAM TOOTH ON K20A

The Honda K20 has an extremely god cam sensor setup. Some engines though seem to exhibit an odd oscillation in the exhaust cam. This can lead to the ECU reporting cam sensor errors. If this happens then this check mark changes the tooth edge the ECU uses as the reference edge. This moves the reference point 15 degrees and will eliminate the problem. Note that the cam sensor position (above) will need changing.

## 10 USE 20 X 14 INJECTION ANGLE MAP

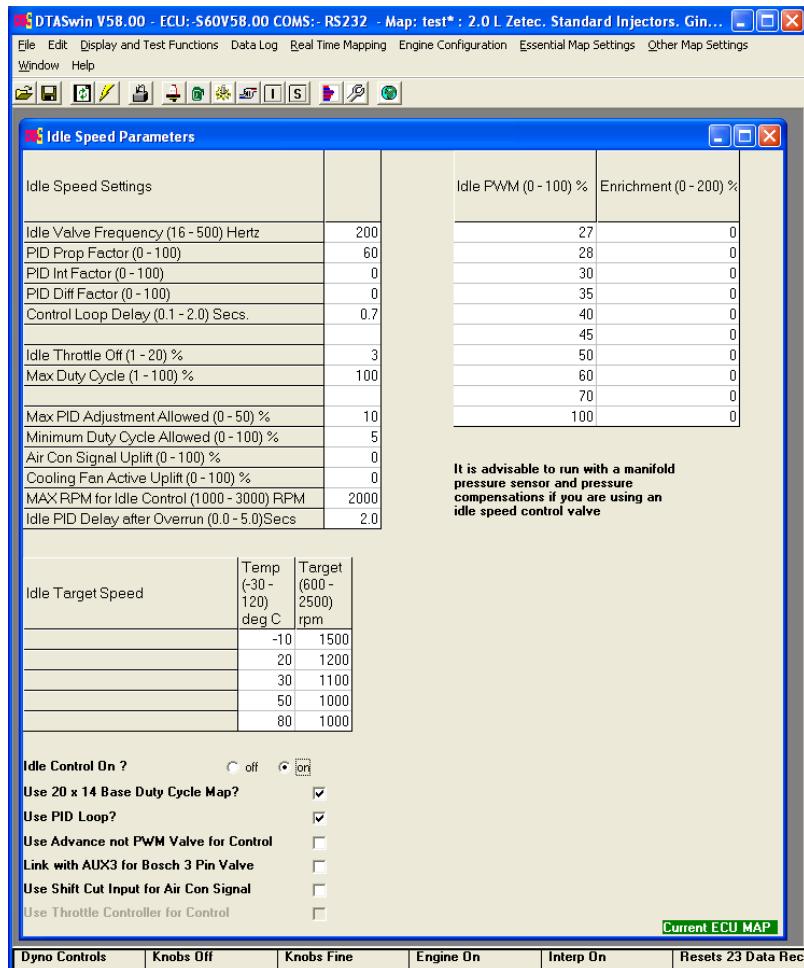
Allows the injection angle, discussed in 1 above, to vary with speed and load of the engine. See Essential Map Settings/Injection Angle Map.

## FAN RELAY SETTINGS

Just enter the temperature that you wish the fan to turn on. The hysteresis is variable from V62 on. Suggested value is 3 degrees C but you may need more if the fans turn on and off too rapidly.

# IDLE SPEED

Windows menu:- Other Map Settings/ Idle Functions/Idle Speed Parameters



## IDLE VALVE FREQUENCY

This is the frequency at which the idle PWM valve operates. Initially try 200 Hertz.

## PID FACTORS

These factors are used in controlling the amount of air going through the valve to keep the idle speed as you require it. PID control loops are a well established method of achieving this. Initial settings of 40, 20 and 0 should be tried. If the idle speed oscillates up and down initially reduce the proportional factor. If the idle speed does not respond quickly enough increase the proportional factor. The integral factor should not normally be above 20. See end of manual for description of PID loops.

## CONTROL LOOP DELAY

The value of this is very engine dependent. Manifold size, valve size, flywheel size are all influencing factors. Essentially this is the time delay between the PID loop making a change to airflow and looking again at the RPM to see what effect it had. If this time is too low then the engine speed will oscillate above and below the target speed. If it is too high then the idle speed will not respond quickly enough to small engine speed variations.0.5 seconds would be a good starting point.

## IDLE THROTTLE OFF

Below this throttle position the idle control is turned on. Above it is turned off.

## MAX DUTY CYCLE

This is the maximum allowed duty cycle of the valve. Setting a low value has the same effect as restricting the size of the valve.

## MAXIMUM PID ADJUSTMENT ALLOWED

Limits the excursions the PID controller is allowed to make to the base PWM figures.

## MINIMUM DUTY CYCLE ALLOWED

Whatever the 20 x 14 base map and the PID controller try to do the duty cycle cannot fall below these figures. This is a very important number and must be set accurately as it helps to eliminate the control system causing the engine to stop after a prolonged period of the engine being driven by the vehicle, for example stopping at a roundabout or junction.

With the engine warm and the idle controller acting stably note the resulting total PWM%. Set the minimum duty cycle to only 1 or 2% less than this resulting PWM.

## AIR CON SIGNAL UPLIFT

Pulse width added to basic signal when air conditioning compressor is engaged, see wiring diagram.

## COOLING FAN ACTIVE UPLIFT

Same as above but works when cooling fan is switched on by the ECU.

## MAX RPM FOR IDLE CONTROL

Idle control will be off above this RPM and the valve will be closed

## IDLE TARGET SPEED

Target speeds for the PID controller base map combination at differing water temperatures.

## USE 20 X 14 BASE DUTY CYCLE MAP

Uses the main PWM map to produce most of the required pulse width to run the engine at the required speed. Absolutely essential that this is turned on.

## USE PID LOOP

Allows the system to trim the base PWM% to achieve the required target speed. See the tutorial on PID loops elsewhere in this manual.

## USE ADVANCE NOT PWM VALVE FOR CONTROL

Allows the use of engine advance for idle speed control on engines with no PWM valve fitted. Not as effective but better than nothing. If using this then set the butterflies more open than normal idle the engine with very small advance figures when hot. In this condition giving the engine more advance will naturally cause it to speed up in the same way as opening a valve would.

## LINK WITH AUX3 FOR BOSCH 3 PIN IDLE VALVE

Some Bosch valves are un-sprung and need driving both ways. This allows the use of the idle valve output in combination with AUX3 to achieve this. See wiring diagram.

## USE SHIFT CUT INPUT FOR AIR CON SIGNAL

This is where the input comes from if you require air conditioning pump uplift.

## IDLE PID DELAY AFTER OVER RUN

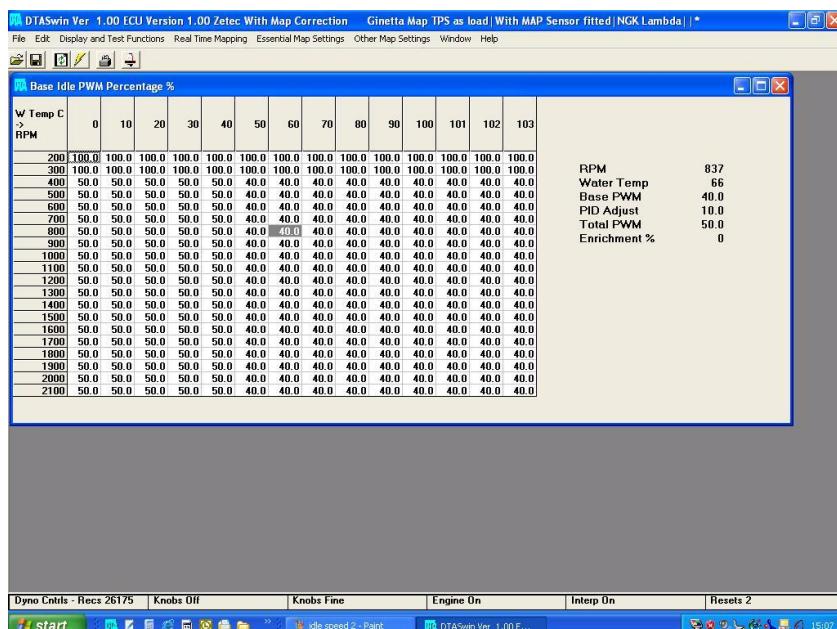
This delays the PID controller from turning on until some seconds after the engine has passed through the MAX rpm for idle control when decelerating. This prevents the engine from stalling when decelerating on zero throttle without the clutch being depressed. This typically happens when slowly coming to a stop at a junction for example.

## FUEL ENRICHMENT AT DIFFERING IDLE PWMS

This allows compensation to be made for different loadings on the engine and still maintain correct lambda values. A simpler method is to use a manifold pressure sensor and use fuel compensation based on this. This will automatically compensate for increased air flow when the valve opens (say to compensate for increased load caused by a fan or main lighting).

## BASE IDLE PWM PERCENTAGE

This must be used at all times for successful implementation of idle control.



These are the base pulse widths used by the idle controller. When the engine is idling your position in the map is indicated at all times. All actions of the controllers are displayed in real time.

Idle RPM scale and temperature scales are self explanatory.

## How to Set The Idle Parameters When Using a PWM valve

First fill out the tables as per the figures above in idle speed parameters. In most cases unless you can measure the frequency of the idle valve control in its original application you will have to try various frequencies by trial and error.

Turn ON the check mark "Use 20 x 14 Base Duty Cycle Map". Make sure the PID loop is turned OFF.

Start the engine and adjust the percentage in the base map until the idle speed is 100 or 200 RPM above the desired idle speed at that engine temperature. You have to do this for each engine temperature so it can take some time.

When this has been achieved turn ON the PID loop. The PID controller will attempt to bring the idle to the appropriate speed. If the idle speed oscillates reduce the PID prop factor and/or increase the closed loop delay. If the response is too slow increase the PID prop factor and/or decrease the closed loop delay.

## BATTERY COMPENSATIONS

*Windows menu:- Other Map Settings/Battery Compensations*

Assuming information is available from your manufacture of coils and injectors this function can be filled out and used. Such information is not easy to obtain in a lot of cases. The table is self-explanatory.

## VARIABLE CAMSHAFTS

Windows menu:- Other Map Settings/Cam Parameters/VTEC Control

Sophisticated variable camshaft control is becoming an ever more present aspect of modern engines. Some of the control aspects for these are very simple such as the Honda V-TEC system. Simple switching systems like this can always be used via the V-TEC output on the S series ECU (or the shift light on the S40).

Continuously variable angle systems are more complex and usually requires us to have developed a solution especially for that engine. The following systems have been developed at the time of writing this manual and more will no doubt be done as time progresses.

Honda K20A iV-TEC

Toyota 2ZZ

Ford ST170

Rover VVC

BMW S50 Single VANOS

BMW S52 Twin VANOS

BMW S54 Twin VANOS

Nissan 350Z

The internal differences required to handle these various systems is effectively selected when the relevant flywheel mode is selected in General Engine Settings.

The cam control system is made up of several maps to control up to four camshafts. The parameter map is shared and common between the cams and each pair of cams has its own cam target map and base PWM map. When four cams are being controlled on a V engine then Cams 1 & 3 are linked and 2 & 4 are linked, that is for example, 1 & 3 are the inlets, 2 & 4 are the exhausts. Note that the base PWM map is not used for the following engines:-

Rover VVC

BMW S50 Single VANOS

BMW S52 Twin VANOS

BMW S54 Twin VANOS

and is set to a fixed value for:-

Honda K20A iV-TEC

Toyota 2ZZ

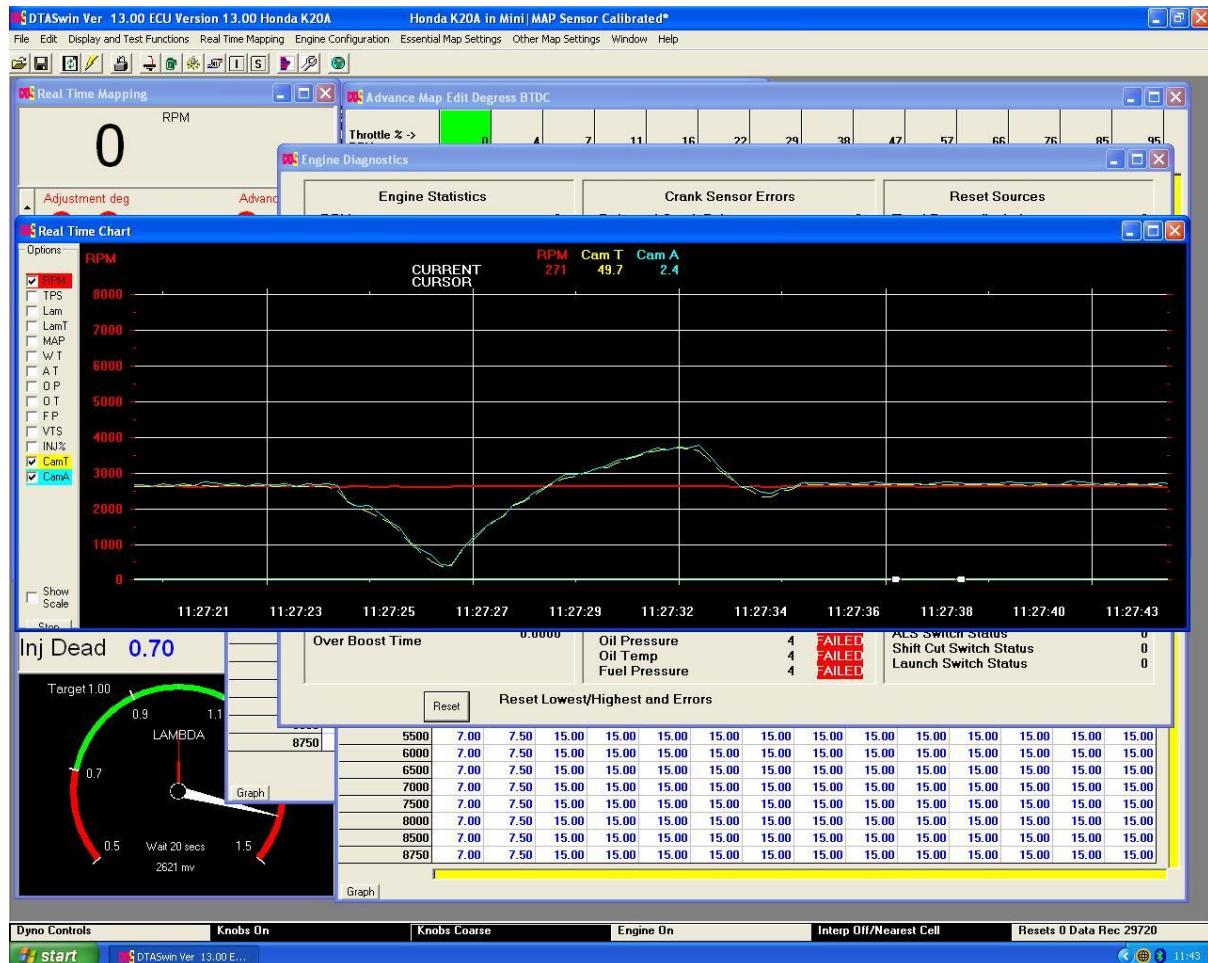
Ford ST170

Nissan 350Z

### SETTING THE CAM SHAFTS

As with all the engine variables we control, the cam position must be optimized. This can be done in real time mapping using the dyno-box. By pressing F7 when in real time mapping the left hand knob of the dyno-box adjusts the target cam angle. This can then be rotated to find maximum power in real time just as you would with the advance and fuel knobs. This operation is safest when the engine is being run closed loop on the fuelling. When the optimum has been found then pressing the enter button will record the current fuel and advance as normal and the cam target will also be recorded. Pressing F8 will make the knob control cam2 target position.

The cam position must accurately follow the target. This can be verified to be happening using the real time chart with the CamA (cam advance) and CamT (cam target) options checked. This should result in the kind of picture below. The actual cam advance (blue line) follows the cam target (yellow line) closely.



The individual map entries are described below.

#### CONTROL VALVE FREQUENCY

Frequency of the oil valve operation.

#### PID FACTORS/CONTROL DELAY/DUTY CYCLE MAX-MIN

Refer to idle speed control for details of these items.

#### NO CAM OR V-TEC CONTROL BELOW WATER TEMP

No action will take place until this water temp is exceeded

#### CONTROL DELAY AFTER ENGINE START

Wait for this length of time before moving cams etc.

#### V-TEC RPM

RPM to switch V-TEC or other simple switching system if throttle value below is also exceeded.

#### V-TEC THROTTLE

Throttle to switch V-TEC or other simple switching system if RPM value above is also exceeded.

#### CAM1/2/3/4 STATIC POSITION

Cam1 value is the same as in sequential injection. Cam2+ may or may not be needed.

#### NO CAM OR V-TEC CONTROL BELOW OIL TEMP

No action will take place until this oil temp is exceeded

#### USE 20 X 14 BASE PWM MAP

Needed on the systems listed above.

#### USE PID LOOP

Needed on the engines which need a base PWM map.

#### V-TEC CONTROL ON

Turn on simple switching output.

#### SWITCH TO MAP2 ON V-TEC

Switches to the second fuel and ignition maps when V-TEC is active

**USE ALS O/P NOT AUX3 FOR V-TEC**

Changes V-TEC output to the ALS output (Pin 32) from Aux3 (Pin 33)

**USE MODIFIED PID**

This is required for engines based on the Denso system. Includes Honda, Toyota and Ford ST170.

**USE CAM2 ADVANCE MAP ON V-TEC**

Normally the cam advance map of for cam 1 is used. This option allows using the cam2 advance map when V-TEC is active.

**USE CAM 1 TARGET ADVANCE FOR BOTH CAMS**

This is used when controlling two inlet cams on a V engine. The system uses only the CAM 1 target advance map for both cams as it is obvious they both need to move at the same time.

**REVERSE CAM CONTROL ACTION**

Used when both inlet and exhaust are variable. The exhaust is usually driven in the opposite direction by the oil control valve. Use these check marks as required. An example is the Audi RS4 V8. The exhausts are driven in the reverse direction.

**CAM STATIC OFFSET TABLE**

In almost all variable cam shaft systems there is a fixed offset even when the cam is in its most retarded position. Filling in this table allows this to be reduced to 0 to make control possible.

## TEST POWER CIRCUITS

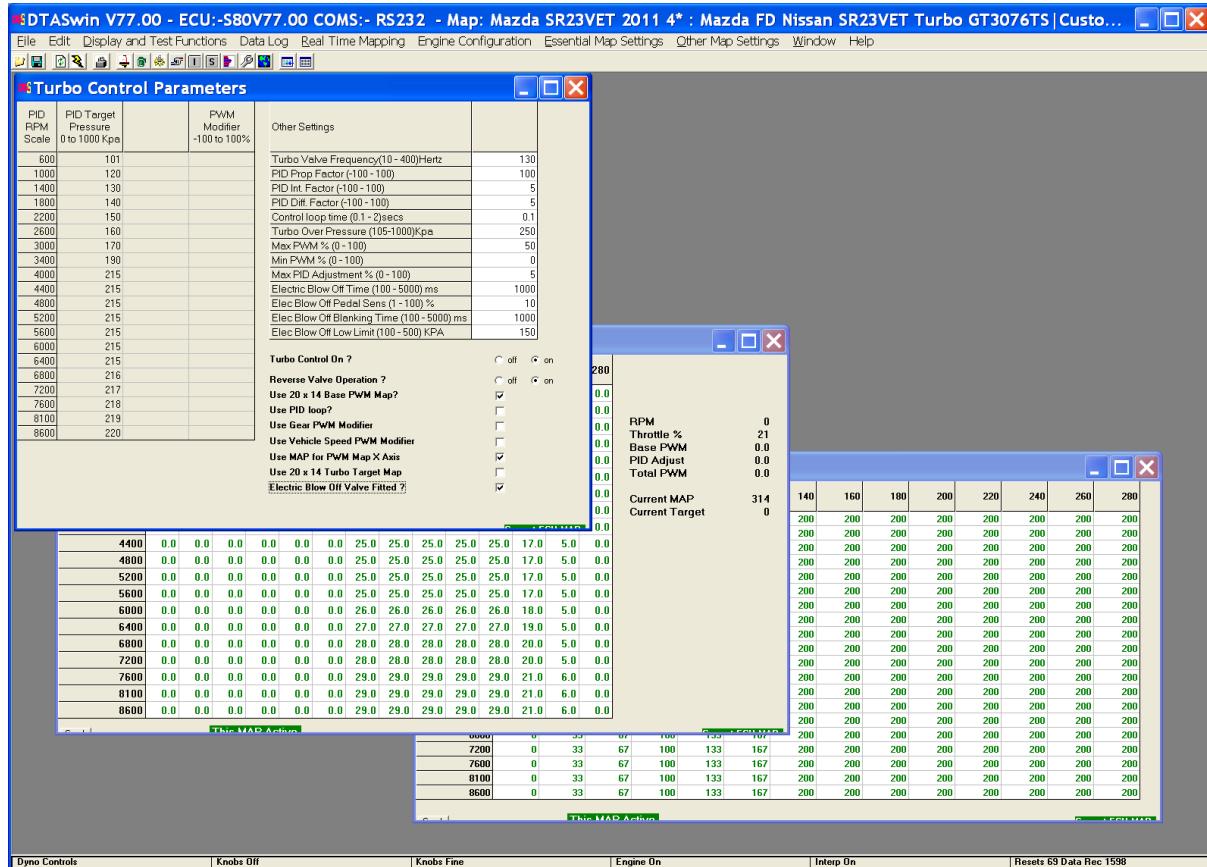
*Windows menu:- Display and Test Functions/Test Injectors and Coils*

This section allows the testing of the coil, spark plugs, injectors, wiring and auxiliary outputs without the engine running.

Just follow the instructions on screen.

## TURBO CONTROL SETTINGS

*Windows menu:- Other Map Settings/Turbo Control*



This section controls the manifold pressure via a small valve such as those made by AMAL or LOCTROL. The target pressure is set for any RPM position and the system will ensure this is achieved (if possible given the engine/turbo combination).

- 1 TARGET PRESSURE  
This is the absolute pressure required at the rev band.
  - 2 VALVE FREQUENCY  
This is the frequency of switching of the control valve. Most small valves are happy with about 100 – 200 hertz.
  - 3 PID PROP, PID INT, PID DIFF FACTORS  
These relate to the control system mathematics. Normally set to 50,10,10. Varying these values alters the speed of response of the closed loop control system. If these figures do not work please feel free to contact us for advice concerning your particular installation. See the introduction to PID controllers at the end of the manual. Note these numbers may have to be NEGATIVE i.e. -50, -10 etc.
  - 4 CONTROL DELAY  
This is the delay between the system making a change to the valve and checking to see the result in manifold pressure. It depends on the size of the plenum, turbo and engine. A good starting point would be 0.3 secs.
  - 5 CONTROL ON/OFF  
Exactly what it says. If set to N then no control is used. When set to Y the system regulates the manifold pressure.
  - 6 VALVE NORMALLY ON/OFF  
This determines whether the switch is on or off when the pressure is below the target. When set to O then when the pressure is low the o/p is switched off. The opposite is true when set to F.
  - 7 TURBO OVERPRESSURE  
This turns off the injectors and sparks when the manifold pressure is above this limit. This protects the engine from damage if the boost pressure is far too high.

- 8 MAX PWM%  
Limits the maximum % that will be supplied to the valve. Under no circumstances will this be exceeded.
- 9 MIN PWM%  
Opposite of above, under no circumstances will the PWM% be less than this unless the engine is stopped.
- 10 MAX PID ADJUSTMENT ALLOWED %  
Constrains the maximum adjustment the PID loop can make to this figure.
- 11 ELECTRIC BLOW OFF TIME  
For turbo's with an inbuilt blow off valve these next four values control the timing  
Blow off time is the time the valve is operated after activation. It will turn off again if the throttle is opened again before this time is finished.
- 12 ELECTRIC BLOW OFF PEDAL SENSITIVITY  
Distance pedal must travel (in TPS %) towards closed position in the pedal measuring time (as in Throttle Transients) to trip the dump action.
- 13 BLOW OFF BLANKING TIME  
Time before a repeat blow off activation is allowed when the current event finishes.
- 14 BLOW OFF LIMIT  
Pressure below which no blow off action will happen
- 15 TURBO CONTROL ON?  
Turns the control system on and off
- 16 REVERSE VALVE OPERATION  
This inverts the PWM signal to the valve. We like more percentage in the 20 x 14 map to give higher manifold pressure. With some valves this does not happen and a lower percentage gives more pressure. Turning this feature on rectifies this. Note this purely a matter of our preference and is not required.
- 17 USE 20 X 14 BASE MAP  
Essential that you use this. The base settings can be arrived at by using the alternate function of the left hand dyno box knob in real time mapping. Run the engine at the required speed and load and swing the knob until the desired pressure is achieved, press enter just as you would do with fuel and ignition adjustment. This is a lot safer when the engine is running closed loop fuelling so there is no chance of the engine being damaged by incorrect mixture.
- 18 USE PID LOOP?  
Turns on the control loop over the top of the main map. See tutorial at the end of this manual for an explanation of how PID loops work.
- 19 USE GEAR PWM MODIFIER  
Allows a percentage reduction in from the base map when in the lower gears to reduce manifold pressure and therefore wheel spin.
- 20 USE VEHICLE SPEED MODIFIER  
Exactly the same effect as the above but based on vehicle speed.
- 21 USE 20 x 14 TURBO TARGET MAP  
Allows a full 20 x 14 pressure target to be used by the PID control loop. See PID loop above.
- 22 ELECTRIC BLOW OFF VALVE FITTED  
Activation of blow off control feature.

## Mapping a Turbo Engine

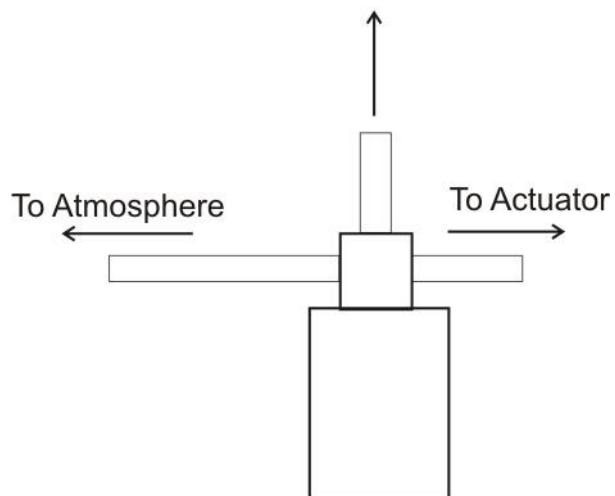
You have a choice with a turbo engine to map with manifold pressure as load or TPS as load and use manifold pressure compensations. The choice is purely personal. Using pressure as load will mean that only a very limited number of cells can be calibrated on the dyno, the rest will be guesswork. Using TPS as load with manifold pressure compensations is our preferred method and many more cells can be calibrated accurately. Manifold pressure compensations ensure that during turbo spin up (lag conditions) then the engine is correctly fuelled.

It is essential that compensations are set before mapping commences if using this method. The software removes the compensation adjustment when mapping to make the map independent of manifold pressure.

Air temperature compensations must always be used, whichever method you are using. High inlet temperatures without compensation will cause the engine to run rich.

Air pressure and temperature compensation maps have a “Set to Standard” button. This is based on established science, ignore it at your peril.

To Plenum

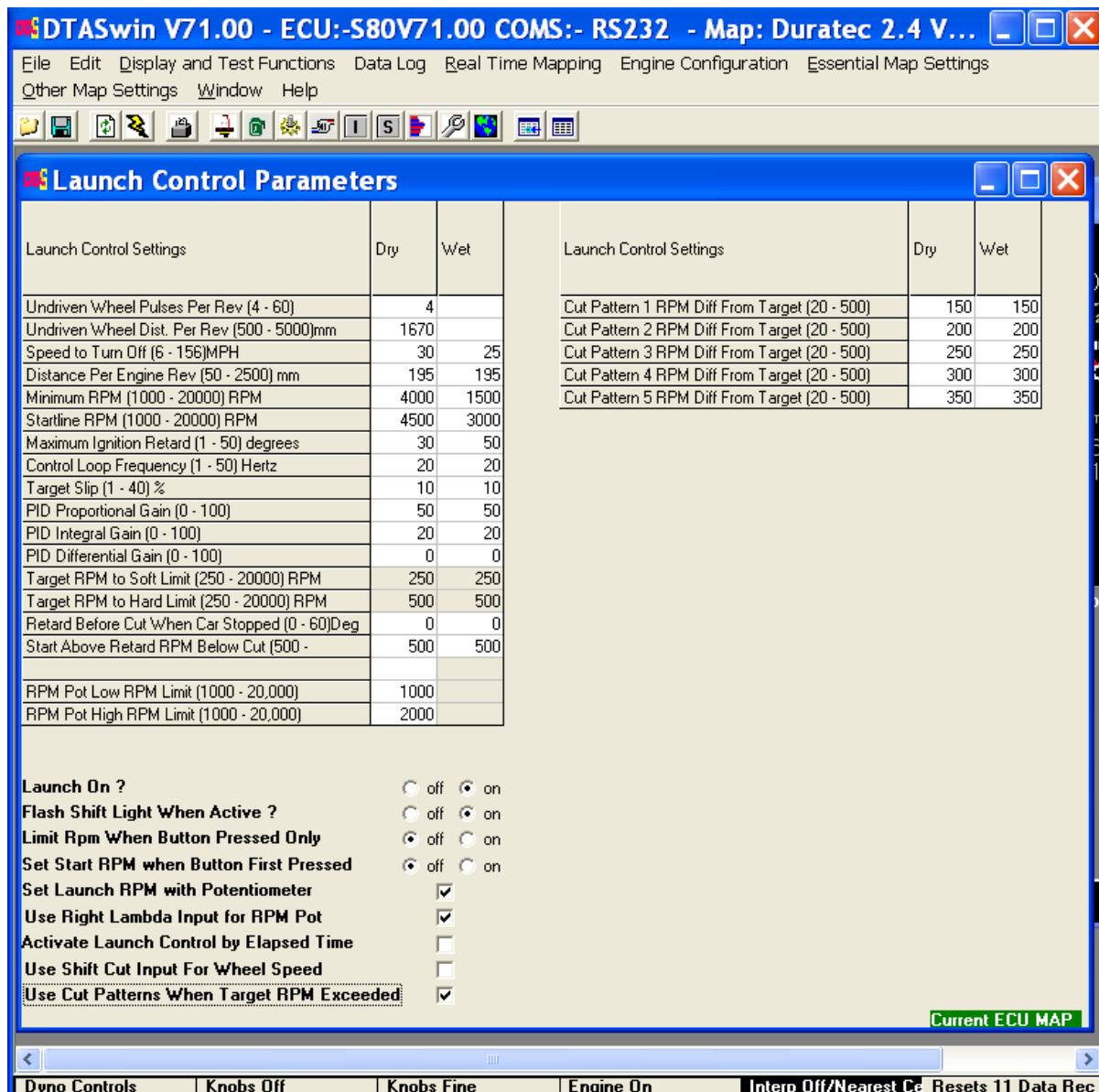


VW Valve pipe connections.

## LAUNCH CONTROL

Windows menu:- Other Map Settings/launch Control

From V68 On Launch Control and Shift Cut have been split into two pages. Variable definitions remain the same.



Launch control is a means of allowing the ECU control of the engine power output during the race start phase to provide the best possible traction from the start line. The driver maintains full throttle at all times, even when stationary with the clutch depressed. As soon as the car begins to move the ECU reduces power output by first retarding the ignition advance and if this still does not control the rpm it will cut one or all cylinders as required to keep the engine RPM to the limits set in this section. An un-driven wheel speed sensor is required (hall effect wired as the wiring diagram) and a push button switch on the dashboard to activate the system. The driver comes to the start line, depresses the clutch and engages gear. The launch control button is pressed (the gear change light will flash repeatedly to signal that all is working) and presses the throttle fully open. The engine will be held at the start line rev limit as set below. This requires the use of the hard cut limit (done automatically by the system) so the engine sounds very peculiar. When the clutch is released the ECU will control the engine revs to maintain the target slip percentage until the turn off speed is reached. After this time it will allow the engine to run free until the button is pressed again.

### 1 LAUNCH CONTROL ON

This is main engagement switch. When set to N nothing will happen. When set to Y when the button is pressed the system is armed and the gear change light will flash. It will continue to

- flash until either the turn off speed is reached or the button is pressed again.
- 2 UNDRIVEN WHEEL PULSES PER ROTATION**  
This is the number of pulses the hall effect sensor sees i.e. if using the brake disc the number of holes in the disc.
- 3 UNDRIVEN WHEEL DISTANCE PER ROTATION (in mm)**  
Self explanatory either measure it or use  $3.142 \times \text{diameter}$ .
- 4 SPEED TO TURN OFF**  
Undriven wheel speed to turn off the system. Normally set to the maximum speed in first gear.
- 5 DISTANCE PER ENGINE ROTATION**  
Distance the car travels in the start gear per rotation of the engine.  
formula :- distance = (wheel diameter x 3.142)/(first gear ratio x final drive ratio)  
example  $(584 \times 3.142)/(2.57 \times 3.89) = 184 \text{ mm}$   
NB. if you change the tyre diameter or the first gear or final drive ratio this needs changing!
- 6 MINIMUM RPM**  
This is the absolute minimum rpm allowed by the control. At this point all retard etc. is removed as quickly as possible so that the engine does not bog down.
- 7 STARTLINE RPM**  
This is the RPM that the engine is held at while using full throttle on the start line. It is also the rpm that is targeted initially immediately the car starts to move. As the speed increases to the point that the target RPM is above this figure the engine is allowed to go faster.
- 8 PID GAINS**  
These figures control the mathematics of this function. Leave as originally set i.e. 80,20,0 unless you have problems, in which read the introduction to PID controllers at the end of this manual.
- 9 TARGET RPM TO SOFT LIMIT/HARD LIMIT**  
The system will initially try to control the engine using ignition retard. If this is not enough then first the soft limit will be invoked at this RPM ABOVE the target, secondly the hard limit will be invoked. The hard limit is very rarely hit in normal circumstances. Note that this is target rpm to so if the start line limit is say 6000 and you want a maximum of 6500 then this should be set to 500, not 6500.
- 10 RETARD BEFORE CUT WHEN CAR STOPPED (Firmware V47 and above)**  
When the car is stopped or the option limit RPM when button pressed only is chosen this and the following number allow for a large ignition retard to be applied. This helps in building boost on the start line for turbo engines. This number is the maximum retard that will be applied. This occurs just before the hard limit applies (at the start line RPM). The RPM band in the next number tells the system when to start. With a startline RPM of 7000, Retard RPM band of 2000 and a maximum retard of 60 degrees then at 5000 RPM there is no retard, 6000 RPM there is 30 degrees and 7000 RPM the retard is 60 degrees. This is added to the advance in the main ignition table to give the actual ignition timing on the engine. Setting the maximum retard to 0 disables the function.
- 11 RETARD RPM BEFORE CUT**  
See above.
- 12 LIMIT RPM WHEN BUTTON PRESSED ONLY**  
With this option no sensor is needed and the rpm is limited to the start line RPM as long as the launch button is pressed.
- 13 SET START RPM WHEN BUTTON FIRST PRESSED**  
The engine start line RPM is set at whatever RPM the engine is doing the instant the launch activation button is pressed.
- 14 SET RPM WITH POTENTIOMETER ON ANA1**  
A potentiometer connected on the ana1 input can be used to set the startline RPM limit between 1000 rpm and the soft rev limit.
- 15 USE RIGHT LAMBDA INPUT FOR RPM POT**  
Allows the pot to wired into the right hand lambda input instead of ANA1. Only available on an S80/S100.
- 16 PIT LANE SPEED LIMIT**  
S80/S100 V53 and above. Allows the Aux Switch input (a push button probably) to limit the maximum speed to the limit entered in the table. Limits the speed only when the button is pressed. NOTE:- Launch control must be turned on in the software (not necessarily used) for this to be functional as it measures the speed.  
From V65 this is moved to its own menu page
- 17 RPM POT LOW / HIGH LIMITS**  
When using a potentiometer to set the launch start line RPM these numbers constrain the

maximum spread the pot can achieve. Fully anticlockwise gives the low limit, clockwise the high one.

18 ACTIVATE LAUNCH CONTROL BY ELAPSED TIME

This feature is used when a wheel speed sensor is not allowed or cannot be fitted. See separate section below.

19 USE SHIFT CUT INPUT FOR WHEEL SPEED

Allows the shift cut input to be used to measure left undriven speed. Note this cannot be used with high tooth counts on the sensor wheel (higher than 8).

20 USE CUT PATTERNS WHEN TARGET RPM EXCEEDED/ CUT PATTERN RPMS

Instead of a simple RPM gap to the soft and hard limits this allows the newer random cut pattern technique to be used. Cut patterns are set in Essential Map Settings/Spark and Fuel Cut Patterns. These come into operation at the target RPM + RPM differences listed in the right hand table. For example if the target RPM is currently 4500 and Cut pattern 1 RPM Difference is set to 150 then cut pattern 1 operates at 4650 RPM.

Please remember that the settings for wet and dry situations are unlikely to be the same. Also in the wet some modulation of the throttle pedal will improve the performance.

S80 and 100 V45 and later have two sets of launch parameters for wet and dry conditions. These are controlled via the traction Wet/Dry switch.

### LAUNCH BY ELAPSED TIME

Ana1 Pot mV -> Time (Secs)	0	980	1960	2940	3920	4900	
0.0	3000	3300	3600	3900	4200	4500	Elapsed Time 0.0
0.1	3211	3505	3800	4095	4389	4684	Ana1 Pot Not Used 0
0.2	3421	3711	4000	4289	4579	4868	Current Target RPM 0
0.3	3632	3916	4200	4484	4768	5053	
0.4	3842	4121	4400	4679	4958	5237	
0.5	4053	4326	4600	4874	5147	5421	
0.6	4263	4532	4800	5088	5337	5605	
0.7	4474	4737	5000	5283	5526	5789	
0.8	4684	4942	5200	5458	5716	5974	
0.9	4895	5147	5400	5653	5905	6158	
1.1	5105	5353	5600	5847	6095	6342	
1.2	5316	5558	5800	6042	6284	6526	
1.3	5526	5763	6000	6237	6474	6711	
1.4	5737	5968	6200	6432	6663	6895	
1.5	5947	6174	6400	6626	6853	7079	
1.6	6158	6379	6600	6821	7042	7263	
1.7	6368	6584	6800	7016	7232	7447	
1.8	6579	6789	7000	7211	7421	7632	
1.9	6789	6995	7200	7405	7611	7816	
2.0	7000	7200	7400	7600	7800	8000	

The rows axis in this table is seconds, the columns axis is the voltage from the potentiometer connected to Analogue 1. Individual tables allow for the setting of each of these axis. The potentiometer on Ana1 is activated by the "SET RPM WITH POTENTIOMETER ON ANA1" check mark. If this checkmark is not set then the first column is used.

The individual table entries are the target RPM for that combination of RPM and Ana1 voltage. The only way to determine the best RPM profile is by experiment.

In use the driver presses and holds the launch button. This engages the RPM figure in the first row at the selected column as the startline RPM allowing the use of full throttle. When the clutch and the

button are released simultaneously the timer will start, the target RPM changing to the appropriate cell selection. The system disengages when the highest time in the last row is exceeded.

# SHIFT CUT SETTINGS

DTASwin V74.00 - ECU:-S100V74.00 COMS:- RS232 - Map: JR...

File Edit Display and Test Functions Data Log Real Time Mapping Engine Configuration  
Essential Map Settings Other Map Settings Window Help

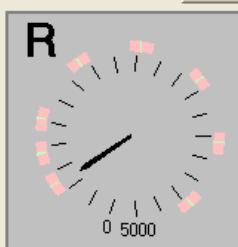
**Shift Cut Parameters**

Shift Cut Settings	Retard After Cut (0 - 60) Deg	Retard For (0 - 500) mS	Gear	Voltage (0 - 5000) mV	Last 20 Shifts	UP Time Ms	End Gear	DOWN Time Ms	End Gear
Shift Cut Delay Time (1 - 500) millisecs	100		R	615	-1				
No Shift Cut Below Throttle (0 - 100) %	5		N	932	-2				
Blanking Window After Cut (0 - 5000) ms	400		1	1264	-3				
Delay (1 - 500) ms, Retard, Time 1st -	100	40.0	2	1909	-4				
Delay, Retard, Time 2nd - 3rd	100	40.0	3	2543	-5				
Delay, Retard, Time 3rd - 4th	80	20.0	4	3178	-6				
Delay, Retard, Time 4th - 5th	70	10.0	5	3823	-7				
Delay, Retard, Time 5th - 6th	50	10.0	6	4455	-8				
Delay, Retard, Time 6th - 7th	50	10.0	7	0	-9				
Delay, Retard, Time 7th - 8th	50	10.0			-10				
Retard if not Using Cut (0 - 100 Deg)	50.0				-11				
Retard Ramp in Time (0 - 500) mS	0				-12				
Post Cut Fuel Increase (0 - 100) %	0				-13				
Post Cut Fuel Increase Time (0 - 500) mS	0				-14				
Shift Cut Start Point (0 - 100) mV	30				-15				
Shift Cut End Point (0 - 200) mV	100				-16				
Number of Gears (1 to 7)	6				-17				
Gear Filter Depth (1 to 10)	4				-18				
Gear Timeout (0 - 500) mS	250				-19				
					-20				

**Shift Cut on ?**  off  on  
**Delay Only ?**  off  on  
**Use Gear Dependant Time Table**   
**Use Ignition Retard not Cut for Shift**   
**Also Cut Fuel During Shift**   
**Use Pot not Switch to Start Cut**   
**Use Pot Position to End Cut not Timer**   
**Use Shift Cut Switch to Enable Pot**   
**Use Switch to Start, Pot to Finish**

**Voltages above 1st must be in ascending order top to bottom**

**Current Pot Volts (mV)** 602  **Reverse Pot Voltage**   
**Capture Voltage**  **Capture**

**R** 

**Shift Cut Timeouts** 0

**Click Here to Unlock Knobs Off** **Knobs Fine** **Engine On** **Interp On** **Resets 0 Data Rec 28**

The gear shift cut section allows the ignition to be turned off when a gear change is in progress with a sequential gear box. The signal is provided by a switch, usually mounted on the gear lever.

- 1    **GEAR SHIFT CUT ON ?**  
Yes no answer, is this function active.
- 2    **SHIFT CUT DELAY TIME**  
Time in milli seconds after the shift signal ends to continue to stop the ignition sparks. Used to allow mechanical settling of the gearbox after engagement. Consult gearbox manufacturer for a suitable figure.
- 3    **NO SHIFT CUT BELOW THROTTLE**  
If the throttle position is below or equal to this figure then no engine cutting takes place. Used to allow engagement of first gear on the start line without stopping the engine!
- 4    **DELAY ONLY**  
This ignores the time the button is pressed and just uses the delay from first contact
- 5    **GEAR BASED DELAY TABLE**  
This allows differing times to change between different gears. Obviously a gear sensor must

be fitted and calibrated in sensor scaling. The gear potentiometer is fitted and shared with Ana3.

Change times may be optimised by using fast logging mode and recording

- |                     |  |
|---------------------|--|
| Shift Cut Switch :- | Shows when switch is active                |
| Ana3 Voltage:-      | Shows exact movement of gear potentiometer |
| Shift Cut Status:-  | Shows how long shift cut is in operation   |
| Gear:-              | Shows current gear                         |
- 6 RETARD AFTER CUT (Firmware V42 and upwards)  
After the shift cut delay has finished the engine can be retarded so power is reduced to eliminate wheel spin after the change. The retardation starts at the figure in the second column and reduces to zero at the end of the specified retardation time. If you are not using the gear dependant table then use the entries in the 1<sup>st</sup> to 2<sup>nd</sup> change.
- NOTE:- This will not help if the cause of the wheel spin is a heavy flywheel.
- 7 RETARD IF NOT USING CUT  
Provided as a less aggressive way of reducing engine power during the gear change event. Instead of completely cutting the engine, a very heavy retard (say 60 degrees+) can be used instead to facilitate load reduction on the gears during the gear change.
- 8 USE IGNITION RETARD NOT CUT FOR CHANGE  
Activates the retard method rather than the complete cut method.
- 9 RETARD RAMP IN TIME  
Ramps in the ignition retard specified above in a straight line over this time. If say 30 degrees is specified for the retard then the retard starts at 0 and increases to 30 degrees in the specified time.
- 10 CUT FUEL DURING SHIFT  
This checkmark adds fuel cut as well as ignition cut or retard during the shift time.
- 11 POST FUEL CUT INCREASE / INCREASE TIME  
If using both fuel and ignition cut or fuel cut and retard then additional fuel may be needed after the change completion. This variable allows for this to be done and ramped out over the specified time.
- 12 SHIFT CUT START POINT & SHIFT CUT END POINT  
The shift cut is started when the ana3 voltage is between current gear centre table voltage + the start point voltage and current gear centre table voltage + the end point voltage. For example if the gear centre voltage is 1200mV and the start point is 50 mV then a voltage of 1251mV will trigger a shift cut. If using pot position to end the cut this is terminated when the next gear centre position – the shift cut start point is reached. If the next gear is 1800mV and the start point is 50 mV then the cut is terminated when the voltage on ana3 = 1750 mV. The end point needs to larger than the start point obviously.
- 13 NUMBER OF GEARS  
The number of forward gears.
- 14 GEAR FILTER DEPTH  
Voltage smoothing filter on gear potentiometer signal. Start at 10.
- 15 GEAR TIMEOUT  
Maximum time before change is considered failed and cut is terminated even if next gear is not reached. A count of these events is kept and disp[layed on the right hand side of the screen.
- 16 USE POT NOT SWITCH TO ACTIVATE  
Allows the use of the gear position potentiometer to activate the gear cut.
- 17 USE POT POSITION TO END CUT NOT TIMER  
With this option the shift cut is terminated when the next gear is seen to be engaged rather than relying on a timer. Also called "Closed Loop".
- 18 USE SHIFT CUT SWITCH TO ENABLE POT  
When using closed loop using the pot to initiate the cut the switch becomes available for other uses. Using this check mark allows the switch to be used as an enable function. Useful for

- times when the pot goes faulty.
- 19 USE SWITCH TO START, POT TO FINISH  
Allows closed loop timing but the advantage of a positive switched start to the cut.
- 20 REVERSE POT VOLTAGE  
If the 5V and GND connections to the pot cannot be changed for any reason this allows the voltage to be reversed in software so the voltage in each gear always rises. Rising voltage with gear is required for closed loop shift cut control. The exception to this rule is neutral which can be between any pair of gears without causing a problem.

#### GEAR VOLTAGE TABLE

When on line to the ECU put the gearbox into each gear in turn, click with your mouse in the voltage column beside the relevant gear then click on the “Capture Voltage” button. This will insert the current voltage into the cell with the focus. Try this several times for each gear to get a feel for the spread of voltages involved.

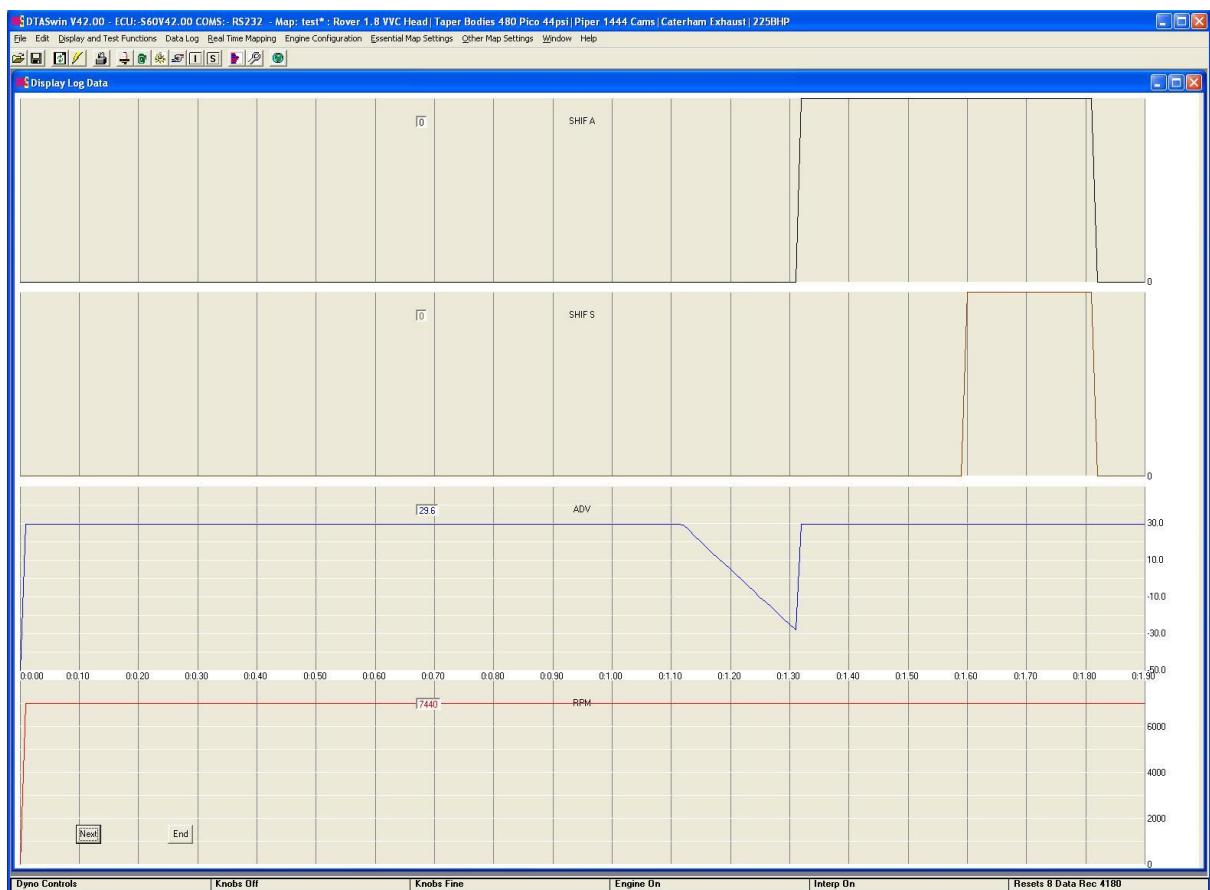
#### GEAR INDICATOR

Largely self explanatory. Gives a visual indication of the current gear, the Dead Band selected and the trip point.

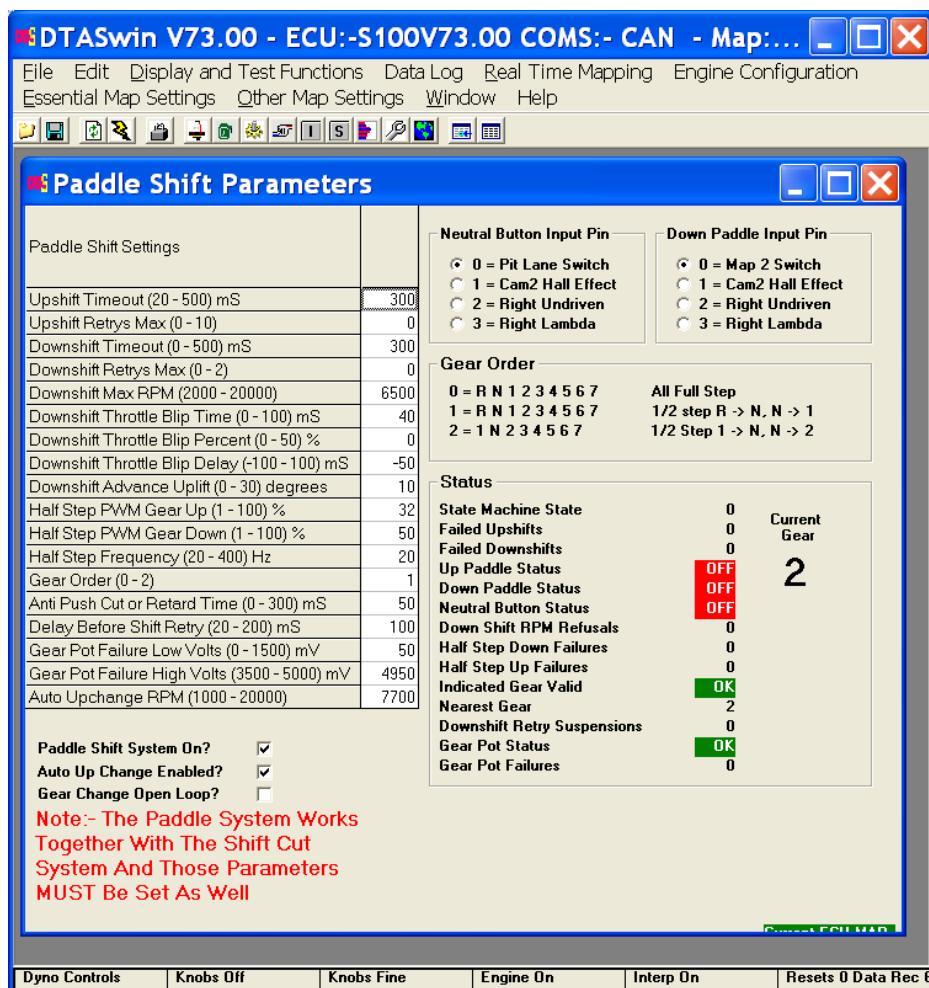
#### LAST TWENTY SHIFTS

Clicking on the button gives an indication of time taken for the last twenty gear shifts in closed loop together with the destination gear.

Below is a log output of actions during a shift cut and following advance retard.



## PADDLE SHIFT – S100 Only



The paddle shift system is designed to work in conjunction with the shift cut system and both need to run closed loop, i.e. Pot to Start, Pot To Finish in shift cut settings. The system expects to see an up paddle switch, a down paddle switch and a neutral button. Outputs are provided for an up valve, a down valve, a throttle blipper and a neutral interlock valve.

A selection of inputs are provided for the down paddle switch and the neutral button, the up paddle is always connected to the shift cut input. Details of these can be found on the wiring diagram.

Any movement of gears below 1<sup>st</sup> requires the neutral button to be pressed e.g. 1<sup>st</sup> to N, N to R, R to N, N to 1<sup>st</sup>.

The above numbers are a working set from our test vehicle equipped with a Ford Duratec engine and a Sadev gearbox and can be used as a start point for most installations.

### Parameter Settings:-

- 1) UPSHIFT TIMEOUT  
Length of time in mS before an attempted shift is abandoned when the next gear has not been successfully reached. If re-trys are enabled a re-try will be executed else another pull on the paddle is required. Make this the same as shift-cut timeout.
- 2) UPSHIFT RE-TRY'S MAX  
Number of re-trys on a failed shift allowed.
- 3) DOWNSHIFT TIMEOUT

Length of time in mS before an attempted shift is abandoned when the next gear has not been successfully reached. If re-trys are enabled a re-try will be executed else another pull on the paddle is required.

- 4) DOWNSHIFT RE-TRY'S MAX  
Number of re-trys on a failed shift allowed.
- 5) DOWNSHIFT MAX RPM  
If the engine RPM is above this limit a downshift request will be blocked and the attempt reported in the status frame.
- 6) DOWNSHIFT THROTTLE BLIP TIME  
Length of time that the throttle blip valve is open for. Found by experiment on the vehicle. Around 50mS suits our car and pneumatic system.
- 7) DOWNSHIFT THROTTLE BLIP PERCENT  
Only applies if you are using an STC to control a FBW throttle system. If you are this is the maximum throttle angle that will be achieved.
- 8) DOWNSHIFT THROTTLE BLIP DELAY  
Note this can be a lead or lag on the blip. If this number is negative then after the down paddle is activated, the blip valve is activated for this length of time before the down valve goes active. If it is positive then the down valve is activated first before the blip. A negative value is normal.
- 9) DOWNSHIFT ADVANCE UPLIFT  
During the blip the ignition advance can optionally be increased. This may help to unload the gearbox dogs. This is not often required.
- 10) HALF STEP PWM GEAR UP AND DOWN  
A pneumatic valve cannot inherently do a half length step for engaging neutral on some gearboxes. By pulsing the valves the selection process can be slowed down such that the ECU can stop the action when neutral is reached. Too low a value and the change does not happen, too high a value and neutral will be bypassed and the next full step gear reached. Just experiment until the most suitable level is reached.
- 11) HALF STEP FREQUENCY  
The frequency of the PWM pulses for the half step. Most likely value to use 20 Hz.
- 12) GEAR ORDER  
Allowable values are 0, 1 and 2. The gear layout these correspond to are on the screen.
- 13) ANTI PUSH TIME  
After a down change the engine may be cut or retarded (depending on the choices in Shift Cut Settings). This may be required to stop the car "Pushing On" after the change. Again experiment at the track with this.
- 14) DELAY BEFORE SHIFT RETRY  
After a failed shift, if re-trys are enabled, this delay allows the valves all to relax to their non operative positions. 100mS should be enough but it can be quite difficult to test as failed shifts should be very rare.
- 15) GEAR POT FAILURE LOW AND HIGH VOLTS  
Tells the system what are allowed voltages for the gear position sensor. If the pot is detected as failed re-trys will be suspended and the system will revert to open loop operation.
- 16) AUTO UPCHANGE RPM & AUTO UPCHANGE ENABLED  
If auto up change is enabled then this is the RPM at which the change will take place. Note auto up change is invoked by pulling the up paddle continuously. As an example when entering the straight after a corner, at the point you would normally select the next gear you pull the up paddle and hold it, subsequent changes will happen automatically at the change RPM. At the end of the straight let go.

## CHECK BOXES

- 1) PADDLE SYSTEM ON  
Self explanatory, turns on system. Note Shift Cut must be enabled and working closed loop.
- 2) AUTO UPCHANGE ENABLED  
See 16 above.
- 3) GEAR CHANGE OPEN LOOP  
Not for use in general but enables you to check the valves are all working as they should.

## STATUS PANEL

Most of these are self explanatory and show obvious error situations and counters. A few odd ones are listed below.

State Machine State:- Internal number used by DTA during development, not of any interest to the end user.

Indicated Gear Valid:- Shows if the gear position sensor is currently within the acceptance band of a gear centre as defined in Shift Cut Settings. If it is not then it indicates the gear pot may not be functioning correctly and therefore re-trys are suspended. This does not stop you pulling for another gear but the system will go open loop effectively in this situation.

The down paddle MUST be released between changes. Continuous down changes are not allowed for safety reasons.

Note the status of all the switches and valves can be logged during fine tuning of the settings. Below is a typical down change log from 3<sup>rd</sup> to 2<sup>nd</sup> :-

RPM	THROT	ANA3	GEAR	SHIF S&P	SHIF A
3842	0	2543	3	DB	0
3837	0	2543	3	DB	0
3814	3	2544	3	DB	0
3812	25	2543	3	D	0
3787	44	2543	3	D	0
3762	42	2544	3	DDV	0
3753	40	2543	3	DDV	0
3724	23	2543	3	DDV	0
3724	3	2453	3	DDV	0
3733	0	2370	3	DDV	0
3702	0	2279	3	DDV	0
3680	0	2130	3	DDV	0
3647	0	2060	3	DDV	0
3750	0	1906	2	A	0
3863	0	1886	2	A	0
3961	0	1885	2	A	0
4120	0	1902	2	A	0
4120	0	1899	2	A	0

Each record is 10 mS. The key on the Shift Switches and Paddles is

D = Down Paddle  
B = Blip Valve

DV = Down Valve  
A = Anti-push

This log shows a 30 mS blip time on a 50 mS blip lead. The down valve is open for 80 mS and once the barrel starts to move (ana3 volts) the change actually takes 60 mS. The anti push is active for 50 mS after the change is complete.

Note also the lag between the blip valve going active and the butterfly moving, air pressure takes time to build up. This is why most situations require a lead on the blip valve.

Below is an up change at full throttle from 2<sup>nd</sup> to 3<sup>rd</sup>.

RPM	THROT	ANA3	GEAR	SHIF	
				S&P	SHIF A
5287	100	1900	2	-	0
5366	100	1899	2	UUU	0
5233	100	1900	2	UUU	0
5323	100	1904	2	UUU	0
5347	100	2001	2	UUU	1
5428	100	2014	2	UUU	1
5247	100	2018	2	UUU	1
4996	100	2021	2	UUU	1
4925	100	2026	2	UUU	1
4822	100	2051	2	UUU	1
4778	100	2145	2	UUU	1
4700	100	2497	2	UUU	1
4605	100	2472	3	U	0
4502	100	2524	3	U	0
4383	100	2563	3	-	0

Each record is 10 mS. The key on the Shift Switches and Paddles is

U = Up Paddle

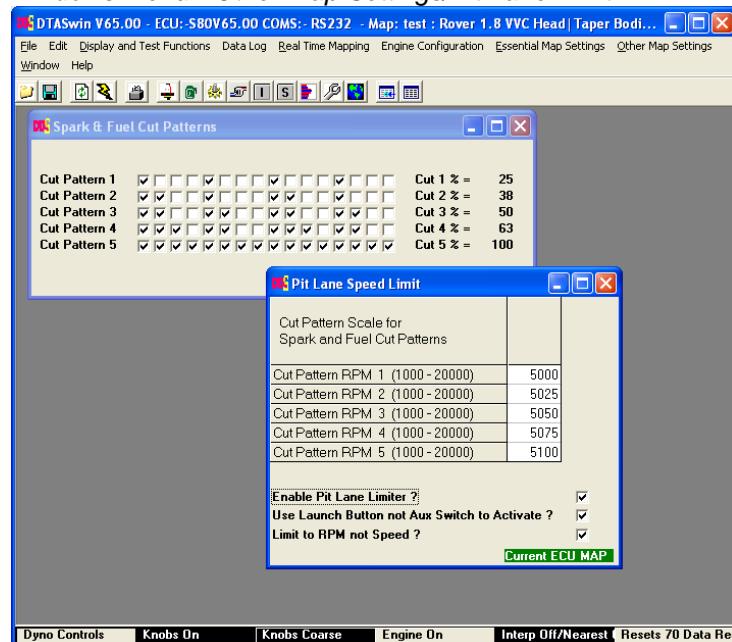
UV = Up Valve

Shift A is shift cut active.

With this change the up paddle and up valve occur simultaneously. After 30 mS the barrel starts to move and shift cut goes active, just as it would with a manual change. After a further 80 mS the shift is complete, shift cut and the valve are deactivated. Note the driver is still pulling the up paddle for a further 20 mS but this is ignored as it is within the Blanking Window set in Shift Cut Settings.

# PIT LANE SPEED LIMIT

Windows menu:- Other Map Settings/Pit Lane Limit



This function is used in association with the spark and fuel cut patterns used for normal RPM limit. This function shifts the RPM or speed at which these cut patterns are effective when the aux switch or launch button is activated depending on settings.

## CUT PATTERN 1 – 5 RPM

This is the RPM or speed at which the associated cut pattern gets activated. The highest numbered cut pattern will normally cut all sparks or fuel or both. Note this is a scale value so must increase from top to bottom.

## ENABLE PIT LANE LIMITER

Turn function on or off.

## USE LAUNCH BUTTON TO ACTIVATE

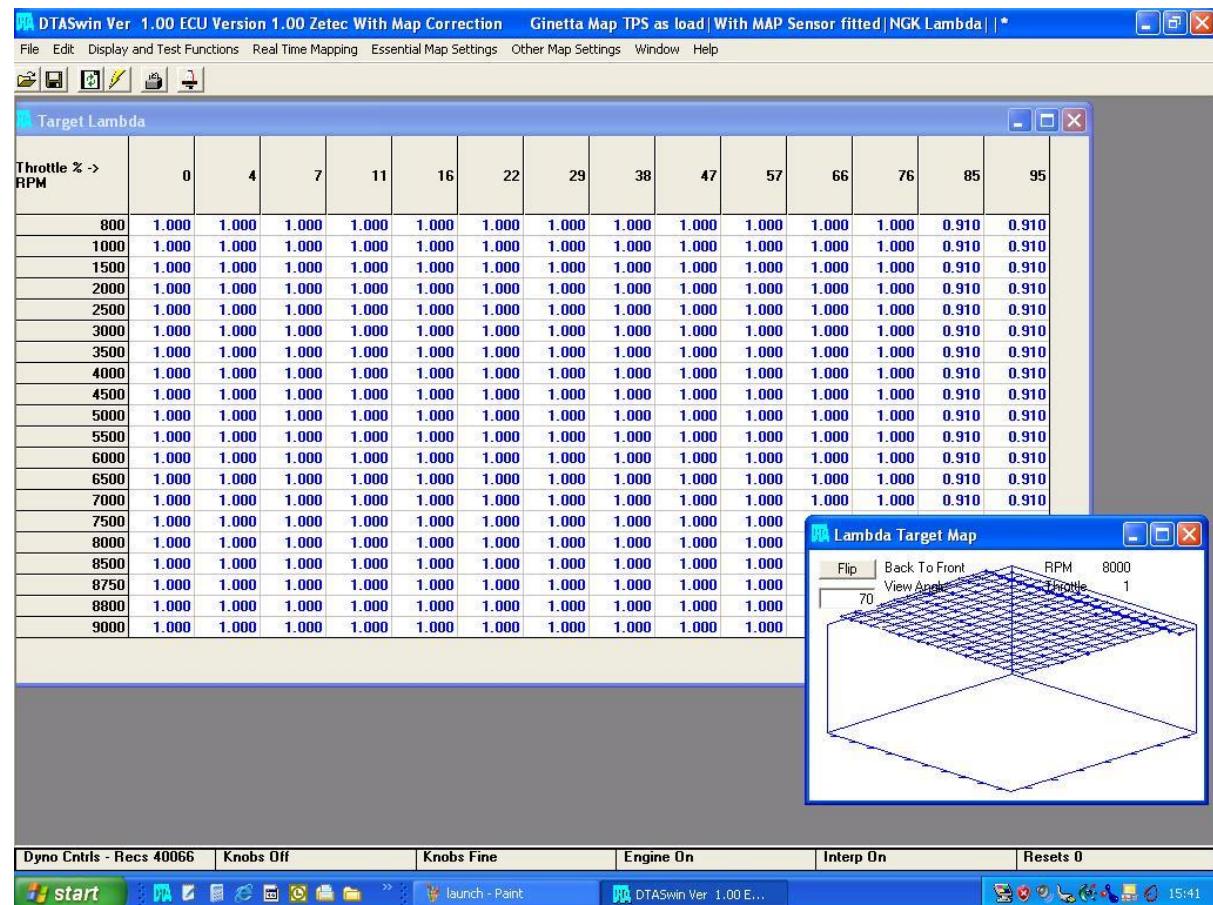
This function defaults to using the Aux Switch input on an S80/S100. If this is not present you can use the launch button instead by checking this box. Note you cannot use the launch feature simultaneously.

## LIMIT TO RPM NOT SPEED

If a speed sensor is not fitted you can use RPM instead. Obviously this only translates to a specific speed in one gear.

# LAMBDA TARGET MAP

Windows menu:- Other Map Settings/Lambda Target Map



This table contains the target Lambda ratio for any point in the operating point of the engine. Minimum is 0.5 and maximum is 2.5. Manipulate as with any other 20 x 14 map. Its operation is governed by a check box in Lambda settings. Above is a typical road car map.

## FUEL CORRECTION MAP

*Windows menu:- Other Map Settings>Show Fuel Correction Map*

When the engine is running in closed loop control the system constantly generates a percentage correction figure to the main fuelling map. When this storage map is turned on in Lambda settings then this percentage is stored in this table. Storage is made on increasing revs and or increasing throttle.

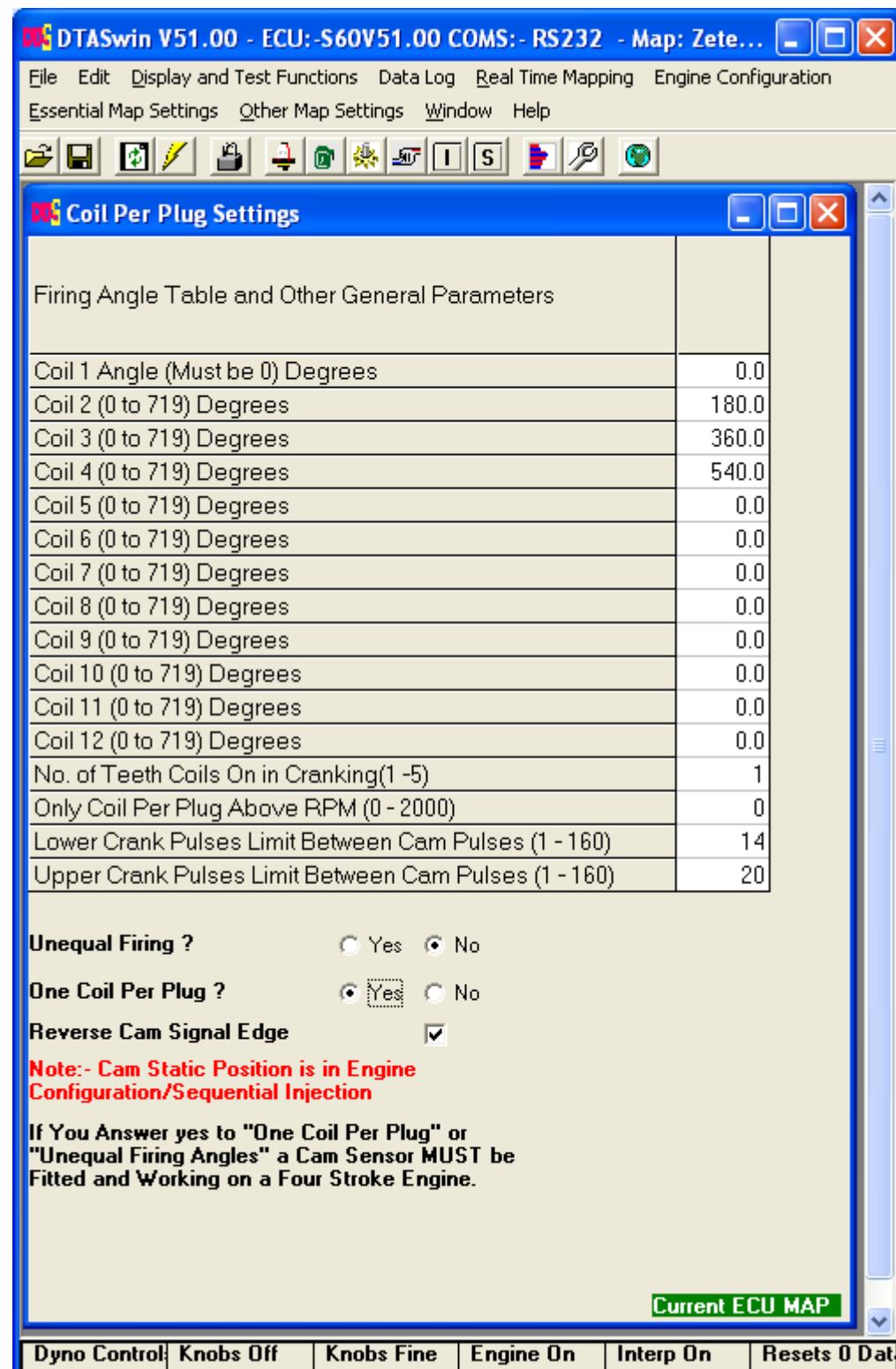
After the vehicle has done some running, generating the figures in this map. Stop the engine and inspect the results. If they look sensible you can use apply and zero. This will combine the stored percentages with the main map and zero the percentage tables. If any individual figure looks suspect you can edit this before combining. If you do not like any of the stored figures zero the percentage figures and try again.

This system works best with a 2 cell Lambda such as an NTK or Innovate available from us with external electronics.

NOTE:- In order to apply corrections to the main fuelling map the main map must be unlocked.

## COIL PER PLUG SETTINGS

Windows menu:- Engine Configuration/Coil Per Plug Settings



Some modern multi cylinder engines do not have equally spaced cylinders in a rotational sense. For example the Cosworth Opel V6 2.5 I ex DTM engine fires at 0, 75, 240, 315, 480, 535 degrees as against a standard pattern for a six cylinder engine of 0, 120, 240, 360, 480, 600 degrees. The first entry must always be zero, the others in order of firing the relevant cylinder spacing.

### NUMBER OF TEETH COILS ON IN CRANKING

Controls temperature build up during cranking in small coil over plug coils. Set to 1 or 2. Increase only if the engine does not fire reliably at starter motor speeds.

#### ONLY COIL PER PLUG ABOVE RPM

This allows an individual coil engine to start without being able to see the cam sensor when starting (usually caused by an inductive cam sensor and a small cam target). The ECU starts the engine as a wasted spark/twin spark engine and changes to using the coils individually above this RPM.

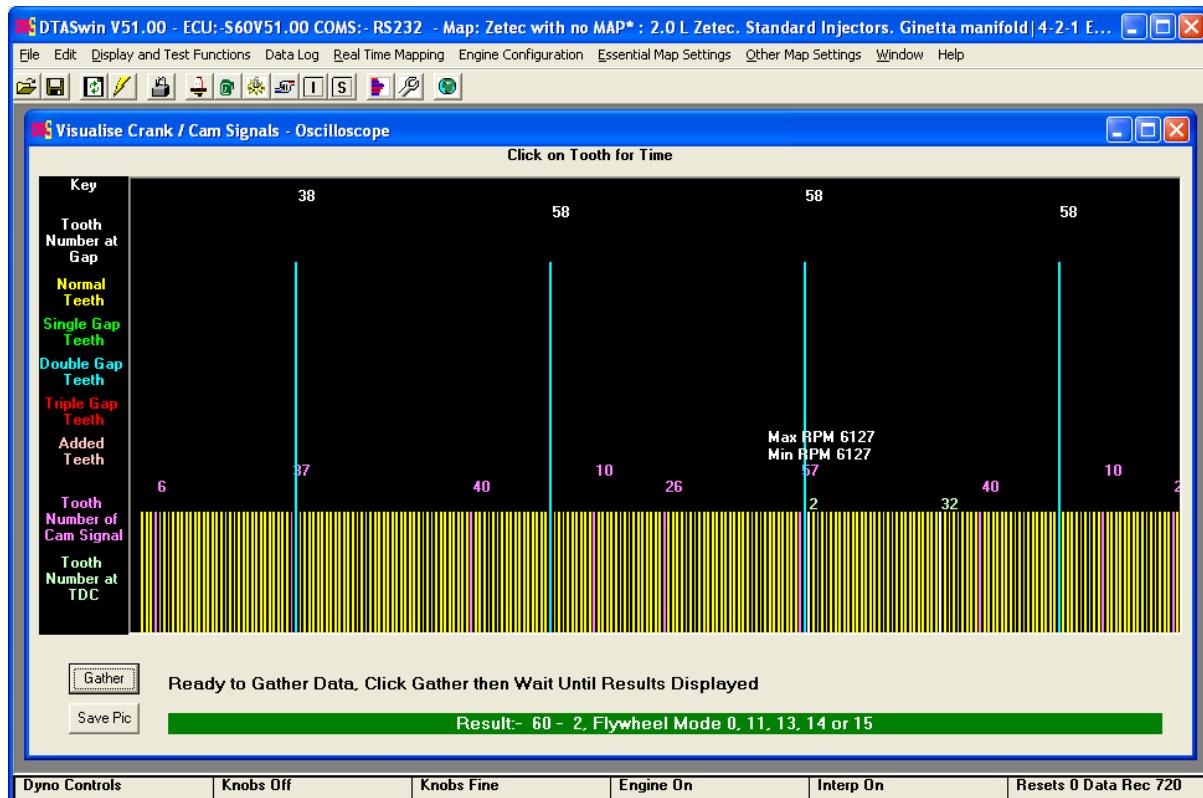
LOWER CRANK PULSES LIMIT BETWEEN CAM PULSES

UPPER CRANK PULSES LIMIT BETWEEN CAM PULSES

REVERSE CAM SIGNAL EDGE

This is part of a special flywheel mode, mode 26. In this mode the ECU counts crank wheel pulses between each cam pulse. Always with these systems one pair of cam teeth will have a unique number of crank pulses between them. In the picture below we have a crankshaft oscilloscope picture from an Audi 1.8T engine. The pink lines representing the cam pulses. The two cam pulses occurring at tooth numbers 10 and 26 are 16 teeth apart. All the others are much further apart than this. We will therefore choose this gap as representing the sync pulse. By entering 14 in the lower limit and 18 in the upper limit then only the tooth at tooth 26 will be accepted and a unique phase reference is created. Choosing the window to be a little wider than we see in the picture allows for any small variation in the signal pattern.

These numbers are used in conjunction with the check mark changing the tooth edge of the cam signal. This only works with hall effect cam sensors. Some cam targets have the rising edge of the cam teeth equally spaced whilst the falling edge is not. The 1.8T is again an example. Checking this mark causes the ECU to look at the falling edge of a tooth rather than the rising edge.



One coil per plug is self-explanatory.

## TRACTION CONTROL SETTINGS

Windows menu:- Other Map Settings/traction Control Settings

### AVAILABLE ON S60PRO AND ABOVE

The traction control system, available on S80PRO models and above, is a full 3 or 4 wheel implementation. It will limit the amount of driven wheel spin to any desired slip compared with the undriven wheels. Note that it is not applicable to 4 wheel drive vehicles. Two complete sets of parameters are available to allow for differing conditions. These are controlled by a switch on the dash of the car. If no switch is used then the dry settings are used. Besides the wet/dry switch an on/off switch must be fitted on the dash. This switch is not optional as the default for this function is off.

On an S60PRO the system uses a single wheel speed sensor and knowledge of the current gear to work out the driven wheel speed from engine RPM. Only one set of settings is available on an S60.

#### MINIMUM SPEED TO ACTIVATE

Below this undriven wheel speed the vehicle is considered to be stopped and the traction control will take no action.

#### MINIMUM RPM TO ACTIVATE

Below this RPM the traction control will take no action. Setting depends on engine performance and the desired car dynamics.

#### MINIMUM THROTTLE TO ACTIVATE

Below this throttle position the traction control system will take no action.

#### TARGET SLIP PERCENTAGE

The system constantly calculates the difference in wheel speed between driven and undriven wheels. Some slip is beneficial to maximum acceleration, say about 20%. Start line situations are different and require the use of Launch Control. If launch control is active then the traction control will take no action until this has relinquished control over the system.

#### BALANCE TO FASTER DRIVEN WHEEL

This setting is used to allow some speed averaging across the two driven wheels. For instance in the case of a free differential it should be set to nearly 100%. In a car with a very stiff limited slip differential it should be set to say 25%.

#### DELAY AFTER START

After the system detects that a car has started to move it waits this length of time before engaging traction control (unless launch is active see above). There is also a delay before the system considers a car is stopped. This is to allow for the locked brake situation. See General Traction Settings.

#### EXCESS SLIP TO HARD CUT (Aggression)

This effectively decides how aggressive the cylinder cutting is when slip is detected. If it is too aggressive the car is unstable. Only testing can determine at what level this should be set. Note a LOW number makes the system more aggressive, a HIGH number less so.

#### ANA1 MINIMUM / MAXIMUM AGGRESSION / USE ANA1 TO SET AGGRESSION

When using a potentiometer connected to the ANA1 input to allow a dashboard settable "Aggression" for the traction control these numbers set the allowable range of settings. Because the switch on an S60 is not available to turn traction on and off, this knob allows the traction control to be turned off. A voltage above 4850mV presented to the ANA1 input turns off the traction control system.

## MAXIMUM IGNITION CUT PERCENTAGE

Provides an upper clamp on the amount of cut (aggression) which can be applied. Stops the engine being given a hard cut which can be unsettling.

## USE UNDRIVEN WHEEL SPEED AND GEAR TABLE

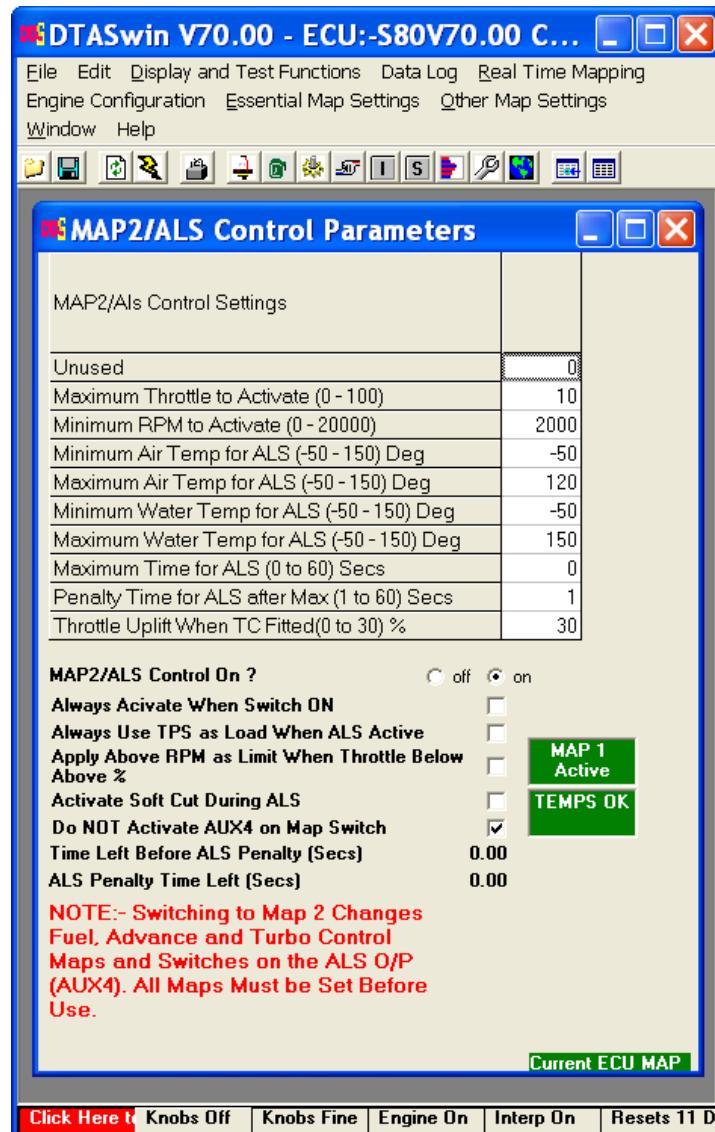
The only method available on an S60, an alternative method on an S80 and above. The distance table must be filled out for each gear. This is the distance the vehicle travels for each rotation of the engine. This can be measured or easily calculated if you know the gear and final drive ratios.

NOTE That if launch control is activated then traction control will not engage until this has finished operating.

## ALS/MAP2 CONTROL SETTINGS

Windows menu:- Other Map Settings/ALS/MAP2 Control Settings

**NOTE THAT IN ALL CIRCUMSTANCES WHEN THIS IS ACTIVATED ALL THE MAP2 VALUES MUST BE SET, THIS INCLUDES IGNITION, FUEL AND TURBO MAPS IF TURBO CONTROL IS IN USE.**



This section controls the function of the turbo anti lag system or can just provide two switchable main maps.

**WARNING:- TURBO ANTI LAG WILL RAISE THE EXHAUST VALVE, MANIFOLD AND TURBINE TEMPERATURES TO VERY HIGH VALUES. THIS MAY BE DETRIMENTAL TO THEIR LIFE. USE WITH CARE AND REMEMBER THAT TO RUN A LOT OF ANTI-LAG YOU NEED A BIG RACING BUDGET.**

This anti lag system works in conjunction with an on/off switch on the dash and a solenoid controlled air valve. The bigger the valve the more retard will be needed and the more turbo pressure will be achieved. When in the anti-lag condition the valve is opened and the ignition map is switched to the ALS Ignition Map which will have large negative values to reduce the engine power even though air is entering the engine and it is firing. Because the engine is firing the turbo keeps spinning generating manifold pressure. This will also be associated with loud "popping" in the exhaust.

### MAXIMUM THROTTLE TO ACTIVATE

Below this value the ALS is active. Above it switches off. Set to 100 if you want to use 2 separate main maps.

#### MINIMUM RPM TO ACTIVATE

Below this RPM the ALS system remains inactive, set to 0 if you just want to use 2 main maps.

#### MINIMUM / MAXIMUM AIR TEMP FOR CONTROL

Disables ALS system when air temp outside these limits.

#### MINIMUM / MAXIMUM WATER TEMP FOR CONTROL

Disables ALS system when water temp outside these limits.

#### MAXIMUM TIME FOR ALS / PENALTY TIME FOR ALS AFTER MAX

This is the maximum continuous time the ALS system is allowed to be active. Works in conjunction with penalty time for ALS. If the continuous ALS time is breached, further activation is disallowed for the penalty time.

To disable this function enter a zero in the MAXIMUM TIME FOR ALS.

Current timings and status of the temperature range inhibitors are shown near the bottom the PC page.

#### THROTTLE UPLIFT WHEN TC FITTED

If a DTA throttle controller is fitted this is the throttle percentage when ALS goes active. This is not available if a TC is not fitted.

#### ALWAYS ACTIVATE WHEN SWITCH IS ON

Implements a simple use of the dashboard switch to activate map2 and the ALS/AUX4 output without regard to any of the normal parameters in the map illustrated above.

#### ALWAYS USE TPS AS LOAD WHEN ALS/MAP2 IS ACTIVE

It is sometimes desirable to use TPS as load when in anti lag rather than MAP even if the ECU is set to do this normally. This check mark allows this.

#### APPLY ABOVE RPM LIMIT WHEN THROTTLE BELOW ABOVE %

This allows the use of an alternative anti-lag strategy if the valve is not available (say on a group N engine). The engine butterfly is opened by a fairly large amount. This will naturally result in a very high idle speed and make the car un-drivable. With ALS turned on in the software and the activation switch turned OFF the RPM to activate becomes the rev limit as long as the throttle is below the "maximum throttle to activate". This allows the engine to be driven normally when the anti-lag switch is off.

When the switch is on the RPM limit returns to the normal one and engine performance at light throttles is controlled by large negative values of advance in the MAP2 ignition map.

#### ACTIVATE SOFT CUT DURING ALS

When the ALS system is activated a rotating soft engine cut is implemented. This is aimed at reducing turbo temperature.

#### DO NOT ACTIVATE AUX4 ON MAP SWITCH

Allows maps to be switched without activating Aux4/ALS Valve output. This frees up Aux4 for any of the other uses it has.

## ALS MAP2 IGNITION / FUEL / TURBO MAPS

These maps are used instead of the main maps when the ALS system is active. Normally large negative values are used in the advance map to limit engine power output when the ALS valve is activated.

WARNING SETTING THESE TO LARGE NEGATIVE VALUES WITH RAISE THE EXHAUST VALVE, MANIFOLD AND TURBINE TEMPERATURES TO VERY HIGH VALUES. THIS MAY BE DETRIMENTAL TO THEIR LIFE. USE WITH CARE AND REMEMBER THAT TO RUN A LOT OF ANTI-LAG YOU NEED A BIG RACING BUDGET.

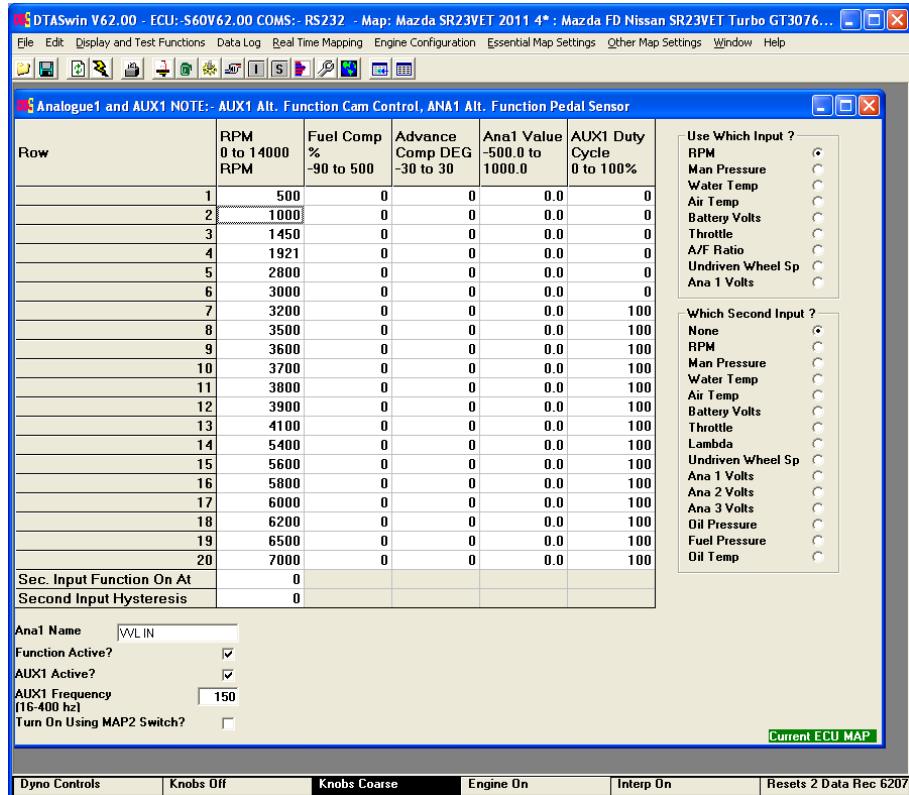
Alter timing by moving the cursor to the chosen place and type in the new figures. Figures are degrees of advance before (negative values after) top dead centre.

If you wish to manipulate a group of cells by a percentage or set to a value, drag the mouse over the group and use the edit menu.

A Fuel map has been added as well as the ignition map. This allows for a separate switchable main map pair. This can be used for many things including a separate map when NOS is used.

# FLEXIBLE ANALOGUES

Windows menu:- Other Map Settings/Analogue1 and Aux3 ETC



These functions are designed to be the ultimate in meeting user defined auxiliary requirements. For instance they can be configured to provide multi stage NOS control, multi-stage water injection, speed related power reduction or even just a straightforward multi stage shift light.

The object is to provide an input, either a dedicated analogue voltage value or any input available to the ECU, to modify fuelling and ignition based on this value and link it to a pulse width valve connected to the output.

## FIRST SELECT YOUR INPUT AND SET SCALE

Select your input from the options on the lower right of the screen. These are self explanatory but the analogue input is an uncommitted 0 - 5 Volt signal from wherever you wish to derive it. Next fill in the scale values (left column) to the range you expect to see.

From V62 onwards a second input is also provided, on any input you choose, which turns on the main function. For instance with the main input set to RPM in the table, the second input could be throttle set to 50%. The function would only turn on above 50% throttle in this case. If the hysteresis is set to say 3% then the function would be on at 50% but would not turn off until 47% was reached. This eliminates hunting or flutter.

## FUEL AND ADVANCE CORRECTIONS

Put in any fuel and advance percentage corrections you wish to see for the given input value.

## ANALOGUE VALUE

These numbers represent the true physical value of what the input voltage means if the input is an uncommitted analogue value. This is only there for your convenience in remembering the function (i.e. if the voltage represents oil temperature put the correct values in here). These values can be logged and displayed in Real Time Info above firmware version 41.

## PWM DUTY CYCLE

This is the on/off percentage of the linked output switch. 0% means the valve is off, 100% means the valve is on. Anywhere in between regulates the flow through the PWM valve (for instance a water injection valve).

## ANA NAME

Another item for your convenience. A reminder of what the function does!

## FUNCTION ACTIVE

Exactly what it says. If this is checked things happen, if not they don't.

## AUX ACTIVE

If this checked then the linked auxiliary is working otherwise it does nothing or has its alternate function (for instance coil 8). Note that function active must be checked as well.

## AUX FREQUENCY

The operating frequency of the linked output.

## TURN ON USING MAP2/ALS SWITCH

This puts the analogue function under control of the external switch. When the switch is turned on the function will work, otherwise no action is taken. This is useful for control of an external valve for controlling, say, NOS or water injection.

Note that there are various other options available in each analogue section which should be self explanatory.

## DATA STREAMS

Windows menu:- Other Map Settings/ Data Stream

### RS232 Stream

The following data is transmitted on pin 2 of the serial connection port at a frequency of 10Hz.

Header Bytes (if selected in software)

Data (all 16 bits, binary, LSB first)

RPM  
Throttle %  
Water Temp C  
Air Temp C  
Manifold Pressure Kpa  
Lambda (Unit Less)  
Battery V (X10)  
Undriven Wheel Speed Kph (x10)  
Oil Pressure Kpa  
Fuel Pressure Kpa  
Oil Temperature C

Check Sum

16 bit subtractive Check Sum, including header bytes.

all RS232 levels at

57600 baud, 8 bits, 1 stop bit, no parity

At 10Hz frequency.

### CAN Stream Specification

#### General

CAN bus Baud Rate	1 MBd
Identifiers	All 29Bit
6 Data Packets	All 8 Bytes Ea.
Send Frequency	10Hz

All Data Values Signed 16 bit sent LSB first (little endian)

#### Data Packets

Identifier	Data1	Data2	Data3	Data4
0x2000	RPM	TPS %	Water Temp C	Air Temp C
0x2001	MAP Kpa	Lambda x 1000	KPH x 10	Oil P Kpa
0x2002	Fuel P Kpa	Oil Temp C	Volts x 10	Fuel Con. L/Hr x 10
0x2003	Gear	Advance Deg x 10	Injection ms x 100	Fuel Con L/100Km x 10

From V62.01 the items below were added.

0x2004	Ana1 mV	Ana2 mV	Ana3 mV	Cam Advance x 10
0x2005	Cam Targ x 10	Cam PWM x 10	Crank Errors	Cam Errors

From V79.02 the items below were added.

0x2006	Cam2 Adv x 10	Cam2 Targ x 10	Cam2 PWM x 10	External 5v
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From V79.04 the items below were added.

0x2007	Inj Duty Cycle %	Lambda PID Target	Lambda PID Adj
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#### FREQUENCY

When using the standard CAN stream the frequency with which the packets are sent is controlled by these radio buttons. Note this is not the CAN baud rate, this cannot be changed.

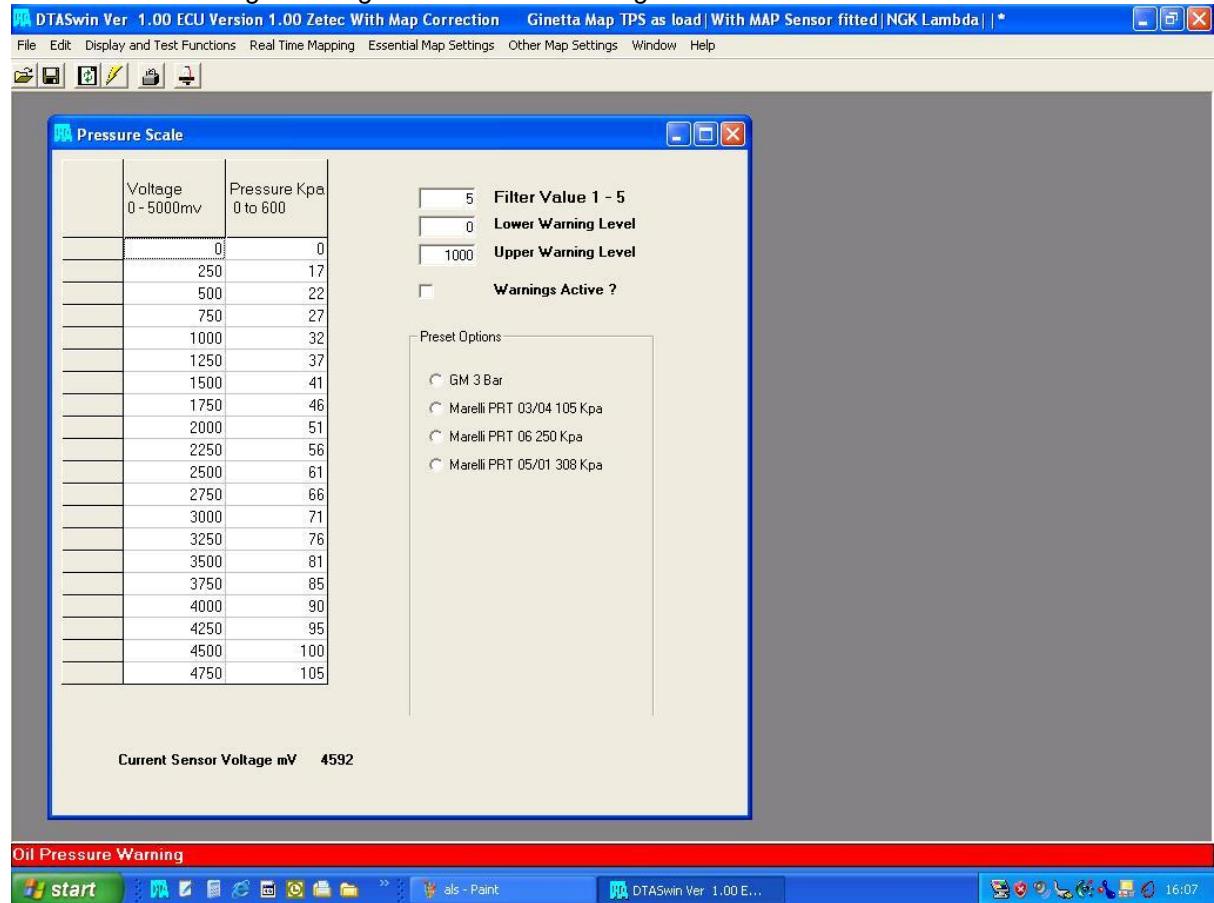
## ELECTRONIC PEDAL SETTINGS

*Windows menu:- Other Map Settings/ Electronic Pedal Settings*

These settings act as a safety feature for an external throttle actuator. It works by having two potentiometers, one on the pedal and one on the butterfly. These are constantly compared and if they differ by more than the allowed amount for more than the specified time then the engine will shut down. This should only occur when either of the sensors fails or the actuator is stuck.

# SENSOR SCALING

Windows menu:- EngineConfiguration/ Sensor Scaling



All sensors can have their voltages scaled to match the calibration curve of the sensors. If the sensor is listed in the preset options just click on the relevant button. If not we may not have seen the particular sensor and may do a calibration chart for you.

## FILTER VALUE

This allows noise filtering. If you do not see any random variations then leave at one. If you do then increase the filter value.

## LOWER AND UPPER WARNING LEVELS AND WARNINGS ACTIVE

If you want sensor warnings when in real time mapping and on the status line (as above) set these to where you want them. The gear shift light (if fitted) will also flash even if the PC is not connected.  
NOTE:- sensor warnings are only active above 900 rpm.

## **ETHANOL COMPENSATIONS**

When running E85 fuel more liquid fuel is required to run the same lambda value, the stoichiometric air/fuel ratio of Ethanol being approximately 8.9:1. The commercial source of this at the pump is E85, this nominally being an 85:15 mix of Ethanol and Petrol. This nominal mix varies depending on the time of year and the age of the fuel and whether the user has added neat Petrol to the tank at any point. Because of this a sensor must be fitted to measure the Ethanol content of the fuel being used. The S series is currently calibrated to use the GM sensor, part number 12570260.

Use of E85 is simple, fit the sensor, turn the system on by saying the sensor is fitted and click on the "Set to Standard" button. The system will automatically add fuel as required.

It is self evident that larger injectors may be required if the vehicle was originally designed just to run Petrol.

# USING TWIN INJECTORS

## *Essential Map Settings/Twin Injector Settings*

These menu options are only available from firmware revision V50.00, before this revision see "General Engine Settings"

When using two injectors per cylinder various options are available. A straight switch between inner and outer injectors can be used as has always been the case, however, from firmware version 50 a blend between inner and outer injectors can be employed. Note that if either injector becomes open for 100% of the time any balance required will be transferred to the other injector.

### Twin Injector Parameters

#### 1) Enrichment on First Switching

When the second injector is used for the first time a percentage enrichment may be added to the demanded fuel pulse for a period defined by the Enrichment Duration parameter.

#### 2) Enrichment Duration

The number of engine rotations the above fuel enrichment is applied for.

#### 3) Switch Above RPM and Above Throttle

If not using the blend map these are the values that cause hopping from one injector to another.

#### 4) Twin Injectors Fitted?

Self explanatory, do NOT check this if you have only one injector per cylinder.

#### 5) Use 20 x 14 Blend Map

Checking this enables the use of the second injector blend map.

#### 6) If Not Using Blend Map Switch On

If just using a straight hop from one injector to the other and not using the blend map this radio button choices selects the load function as throttle or manifold pressure.

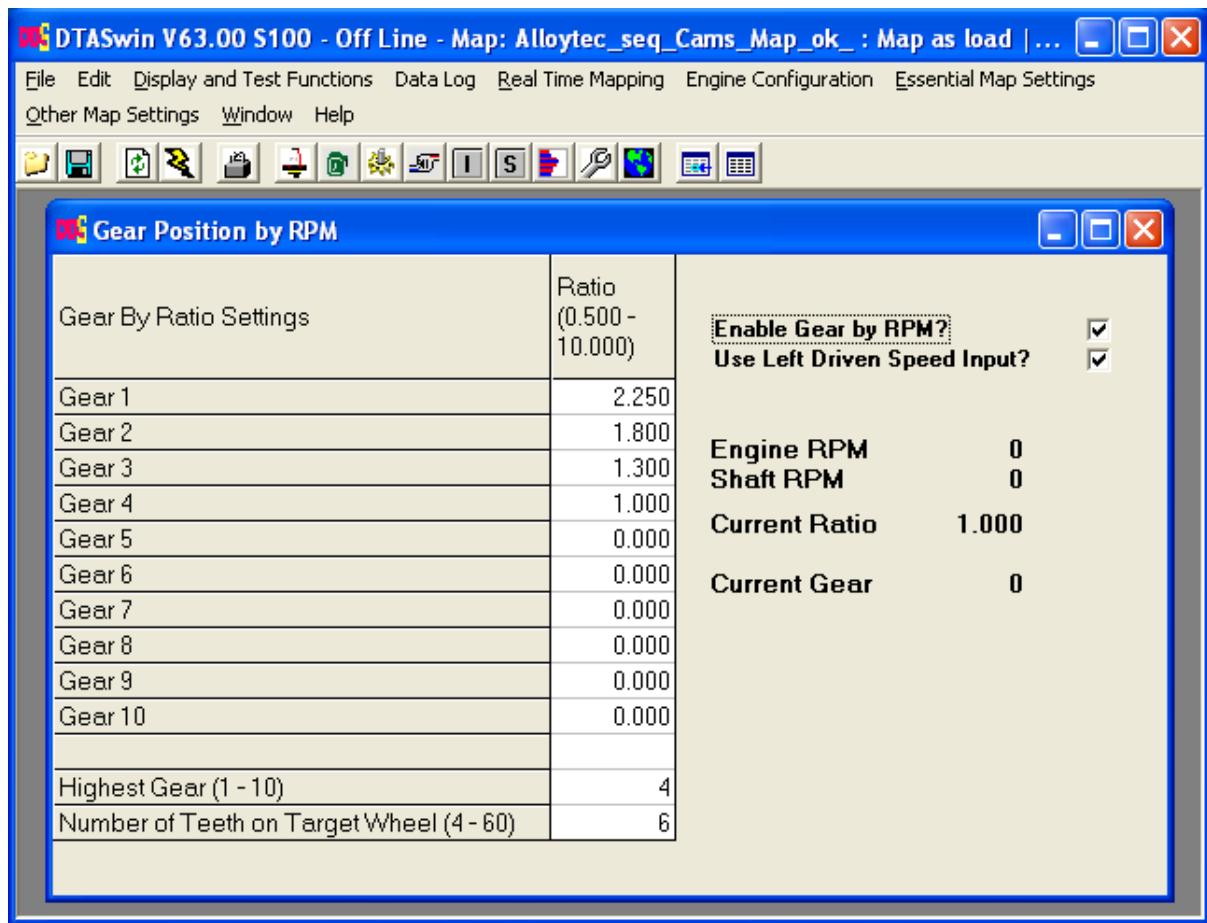
### Second Injector Blend Map

Allocates a percentage of the current fuel pulse to the second injector. 0% means all the fuel is from the first (usually inner) injector, 100% means that all the fuel is from the second, usually outer injector.

If this map contains the value of 30% and the current fuel pulse is 10ms then 7ms pulses are given to the first injector and 3ms pulses are given to the second injector. If ,however, there is only 6ms available for a fuel pulse (this occurs naturally at 20000 rpm in a four stroke engine) then 6ms will be given to the first injector and 4ms to the second.

Note that any active Injector Dead Time is added to both injector pulses.

## CALCULATE CURRENT GEAR WITH SHAFT SENSOR



These parameters cover the calculation of current gear using a hall effect sensor looking at a toothed wheel on the prop-shaft or occasionally hall effect speed sensor built into the gear box. This is connected to the shift cut input and is an alternative function for that pin.

### 1 GEAR RATIOS

The gear ratio's need entering in the table (including any additions caused by drop down gears or final drive). If known these can be punched in directly or the ECU calculates and displays the current ratio on screen.

### 2 HIGHEST GEAR

Highest gear that can be selected.

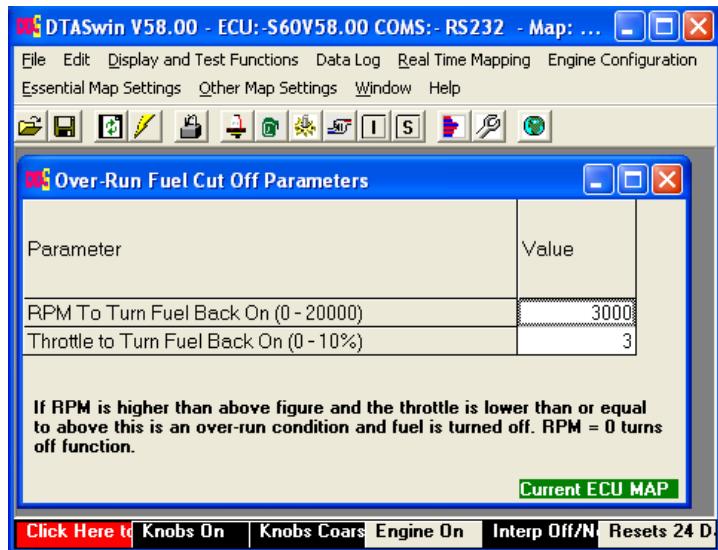
### 3 NUMBER OF TEETH ON TARGET WHEEL

Number of teeth the sensor "sees" in one rotation of the shaft.

### 4 USE LEFT DRIVEN SPEED INPUT

Allows the use of the left driven wheel speed input instead of the shift cut input for measuring the prop-shaft RPM.

## OVER-RUN FUEL CUT OFF



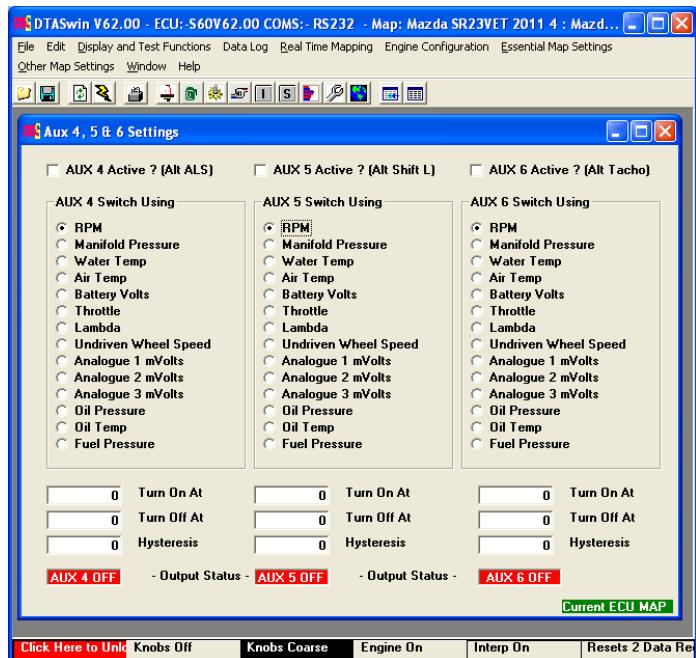
Over-run is a condition when the engine is being pushed by the car. In these circumstances cutting off the fuel reduces the overall fuel consumption.

There are only two settings and the rules are simple:-

If the RPM is above the set value and the throttle is less than or equal to the set value then the fuel is cut off. If either of these rules are not true then fuel is reintroduced as per the rest of the map.

A zero value in the RPM box turns off the function.

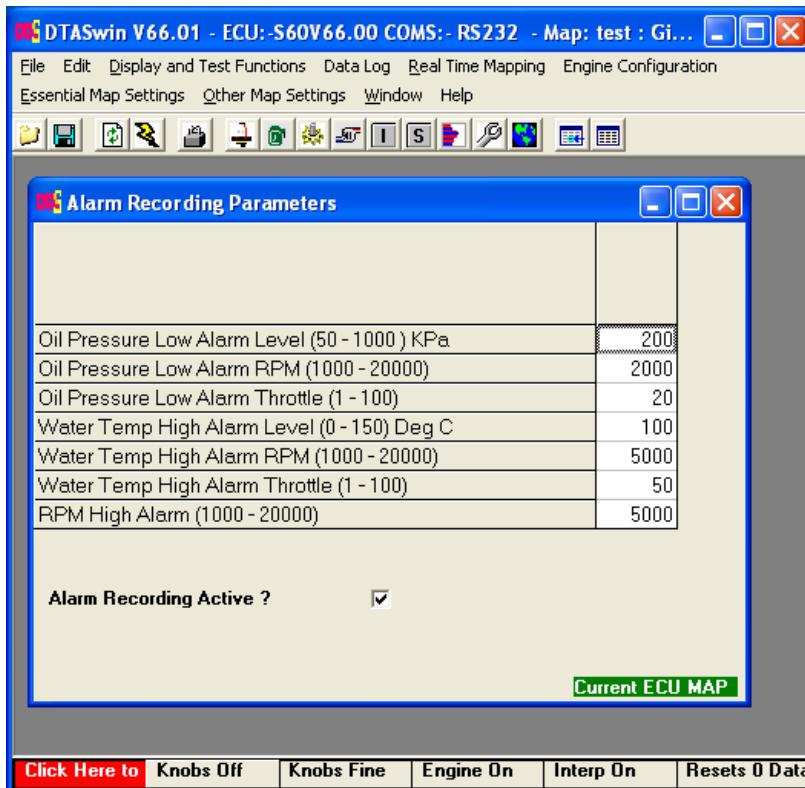
## Aux 4/5/6 & Aux 7/8/9



These are simple switch settings to use either dedicated or dual use auxiliaries in a straightforward on/off manner. They are off when the engine is stopped, turn on at the "On At" value and some higher value may or may not turn off again depending on your settings. Hysteresis may be added if required to eliminate switch bounce.

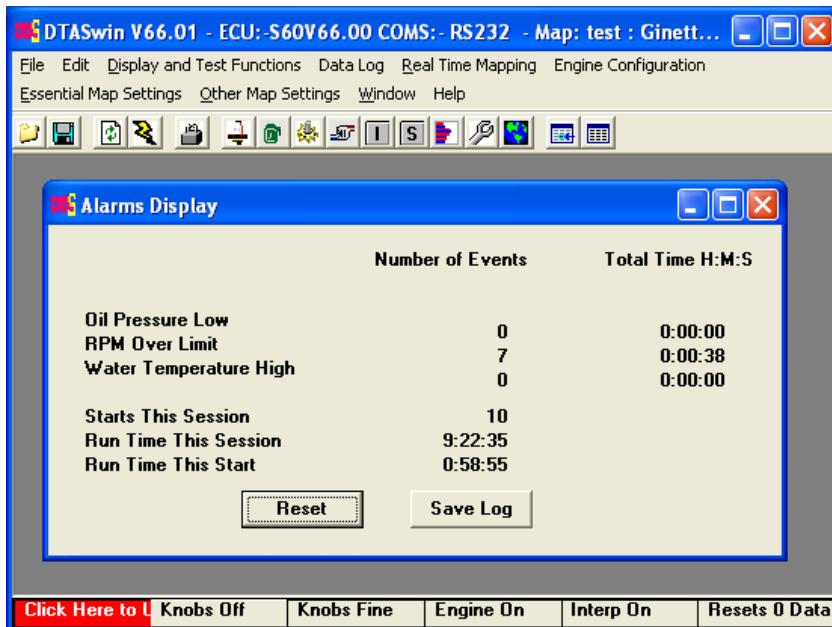
Turn the function on or off using the relevant check mark. They can all be handled individually. If the output is in use by some other dedicated function then this will take priority.

# ALARM RECORDING



Allows the recording of out of range engine operation as described on screen. Alarms are only triggered above the RPM and throttle levels associated with the alarm. The whole function is turned on and off with a simple check mark.

Total alarm numbers and times can be viewed in Display and Test Functions / Alarms Display as below. Reset clears the totals and the log of events. A maximum of 150 alarms can be logged.



The events will also be logged and this can be saved in a format suitable for input into a spread sheet as below.

EVENT TYPE;ENGINE STARTS;RUNTIME THIS START HOURS;MINS;SECS;  
RPM High;1;0;0;0;

RPM High;1;0;0;5;  
RPM High;1;0;0;8;  
RPM High;1;0;0;11;  
RPM High;2;0;0;37;  
RPM High;2;0;0;40;  
RPM High;2;0;0;43;  
End;0;0;0;0;

## FIRMWARE UPGRADING

Download the S Series Flash Programmer from our web site and unzip on your machine or ask DTA for a CD. Purchase a flash programming cable from DTA or add a switch to a normal serial cable as per the wiring diagram.

### 1) Loading the Program

Insert CD in drive or change to the directory you unzipped a download into..

Open the sub directory Disk1 on the CD or the local drive you unzipped to.

Double-click on Setup.exe

The program will then install.

### 2) Using the program

Connect the special flash programming cable between the ECU and the PC.  
Press the button on the cable and turn on the ECU. You can then immediately let go of the button.

Start ST10Flasher

This should load the monitor program and connect to the ECU. Note the default is COM1 at 9600 baud.

If you receive an error message:-

Check that you are using COM1, if not click on the button "Set Port" and alter the COM port as required. Leave at 9600 baud for now.

Turn off the ECU press the button and turn back on. Click on "Reload Monitor". Unless you have serious COM issues this should happen first time.

After "LOAD MONITOR – OK" appears if required increase the baud rate to 57600 in "Set Port", this will make things faster.

Load the file S60VXX.HEX that will be published on our web-site from time to time by pressing the "File to Program" button and browse to the above file.

Make sure the "Auto Erase" check mark is set and click on "Program and Verify"

After "Program Flash Memory → OK" appears, leave the flasher program, turn off ECU. Check that it then responds normally to DTASwin (note you will need the latest version of DTASwin from [www.dtafast.co.uk](http://www.dtafast.co.uk).

## HARDWARE INSTALLATION

The installation of the system is quite simple and problem free so long as the instructions in this section of the manual are followed. All the wiring and timings diagrams for this section can be found at the back of this manual. Please be sure that you use the diagrams relevant to the model of system that you have purchased.

We always mount the unit using extremely aggressive "Velcro" although a stretched "O" ring is equally suitable. Although the S series is extremely waterproof it is still best to mount it in the cab of the vehicle.

## **MAIN CONNECTOR SYSTEM**

The AMP Superseal connectors used on the S series are an extremely reliable system. We supply these as a kit of shells and seals. Note the different keyways on the power and the sensor side. As supplied the locking keys for the pins are open and they will not fit into the ECU.

All the intended connections should be made and the pins fully inserted from the back side (away from the ECU) and it is essential that they are fully home. You can check this from the front side. If they are not fully inserted the white locking buttons will not push home.

A special crimping tool is available from AMP but this is quite expensive. If you do not have a suitable tool then get a professional to make your loom.

When all required pins are inserted the white locking tabs can be pushed home. If you need to remove a pin, unlock the white tabs using a small screwdriver and push the pin out from the front side.

# CABLES

## CONNECTING THE ECU

The main wiring schematics are given at the end of this manual in the appendix. Please ensure that you use the correct diagram for your model of system.

It is essential for proper operation that this diagram is followed exactly. We can recommend a variety of loom makers for bespoke looms fitted to the car or we can supply all the connectors you need to make one yourself. We will also make a loom to specification on receipt of a dimensioned diagram.

## WIRE SPECIFICATIONS

Different parts of the installation have different requirements regarding the type of wire used. Wire grades for a quality wire such as Raychem Spec 44 are given. With the exception of the wire used for the rotational sensors these are minimum requirements to handle the currents generated.

ALL SENSOR CONNECTIONS	250 milli Amp (24 AWG)
ALL POWER CONNECTIONS	10 Amp (22 AWG)
BATTERY NEGATIVE CONNECTIONS	30 Amp (2 x 20 AWG)
CRANK & CAM SENSORS	SCREENED TWISTED PAIR
WHEEL SPEED SENSORS	SCREENED MULTI CONDUCTOR

Suitable light weight and small diameter wire is manufactured by Tyco Raychem (Spec 44 or Flexlite) and available from [www.farnell.com](http://www.farnell.com). Twisted pair for crank sensors is available from ourselves.

# COMPATIBLE SENSOR ACTUATOR PARTS

## ECU COMPATIBLE PART NUMBERS

This list is not exhaustive and other parts will work. If in doubt follow the general rules i.e. so long as a temperature sensor is 2.4 K Ohms at approximately 20 Deg C then it will be fine. If you do not have a sensor then either buy one from us or choose a part off the list.

### Throttle Pot

Almost any linear pot is fine preferable approx. 5KOhms

Bosch 0280 122 001 (3 pin VX/Opel)  
Connections  
1) Gnd  
2) 5V  
3) Signal

0280 122 201

Colvern or Jenvey pot

Ford 88WF9B989  
Rover JZX3491

### Air Temp Sensor (any NTC reading approx. 2.4 KOhms at 20 deg C)

Lucas SNB802  
Bosch 0280 130 039

### Water Temp Sensor (any NTC reading approx. 2.4 KOhms at 20 deg C)

Lucas SNB801  
Bosch 0280 130 026

### Crank Sensor (almost any VR (Magnetic) type)

Ford 6859702  
6181945  
Vx/Opel 904 514 41  
Bosch 0261 210 036  
0261 210 104  
0261 210 001  
0261 210 081 (VW)  
Rover NSC100390

### Lambda Sensor

the following are recommended others will work

Bosch 0258 104 002  
0258 006 127 (EU3)  
NTK TL-7111-W1 (with amplifier TC600) P8 only  
Innovate LC1  
LM1  
LM2

### Ignition Coils

Ford 6503280  
Valeo V245041  
Bosch 0221 503 407  
Bosch 0221 503 001  
Bosch 0221 503 002  
Bosch 0221 503 468  
Connections  
Earth

12V  
cyl 4 (nearest to connector)  
cyl 3  
cyl 2  
cyl 1  
Distributor Coil 0221 118 322

### **Single Ignition Coils**

A word of warning about these. They are generally not chosen by manufacturers for performance reasons but usually some other. Just because they are fashionable, do not assume that they are better!

Audi 06B 905 115 S3(amplified, pin 4 secondary earth, 3 signal, 2 primary earth, 12V)

### **ALS and Idle Valve**

Bosch 0280 140 512 (note this is very large for an idle valve and benefits from restriction)

### **Manifold and Barometric pressure (any 5 volt linear sensor will be fine)**

Marelli APS05/01 (3.0 Bar)  
Marelli PRT03/01 (1.15 Bar)

### **Turbo Control Valve**

VW 0589 062 83F

**Injectors** (any resistance greater than 5 Ohms or described as direct switching, subject to the current rating of the ECU outputs)

Bosch 0280 150 803  
Bosch 0280 150 744  
[Weber Pico](#) Pico330/Pico440

etc.etc.

## NO RS232 PORT?

Firstly, the recommended machine specification for our Windows software is, 1+ Ghz Processor, 256 Meg Ram, 1024 x 768 screen, Windows XP.

If your PC has no COM port we offer, at a very reasonable price, a USB -> RS232 converter. This we know works, others may not.

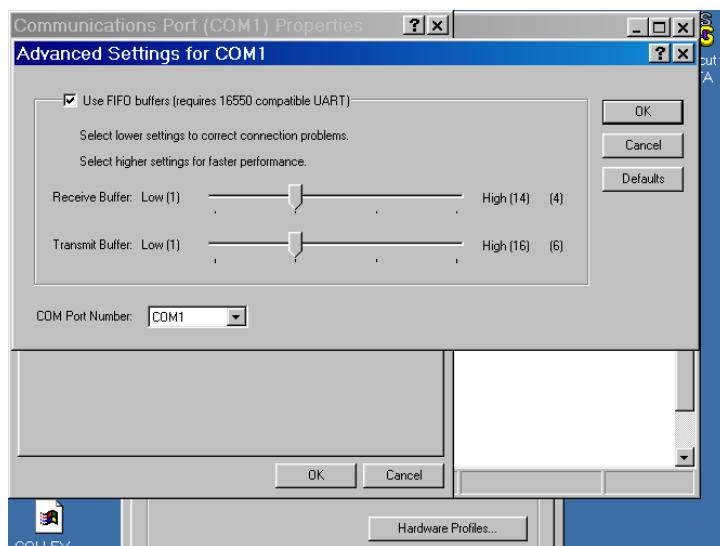
We also offer the ability to communicate via the CAN network. A CAN adapter is more expensive but can be a useful device to have around.

If using an RS232 adapter follow the instructions below.

- 1) Set the adapters com port number using the drop down box as below. Make sure that this is the same the DTASwin software is set to in File/Serial Port Options

- 2) Set the serial port FIFO's

These are to be found in My Computer/Control Panel/System/Device Manager/Ports COM and LPT/Communications Port/Port Settings/Advanced what you should see when you get there is as below.



If the settings are different from the above, make them the same as this. The route to this page varies slightly with each flavour of Windows but is basically the same.

The settings above have a major influence on how your serial link performs.

- 3) Always use the latest version of our software

## PID LOOPS A BRIEF TUTORIAL

Queries about PID loops are about the most common one we receive. PID stands for proportional, integral and differential and it is a long established way of controlling almost anything from industrial oven temperatures to radar aerial rotational speeds.

The technique is used in many places throughout DTA software. Let us use as an example the air fuel ratio PID controller.

It is desirable that the air fuel ratio is held constant at a level determined by power output or emissions requirements. The air fuel ratio delivered is determined by the amount of air being consumed by the engine and the amount of fuel being supplied by the fuel injectors as a result of the main fuel map and all the compensations acting upon it.

The Lambda PID controller modifies the amount of fuel injected into the engine by the following technique. The system measures the current Lambda value from the sensor. It then subtracts this value from the target Lambda value (from either the target Lambdas in the Lambda map or the 20 x 14 Lambda map whichever is in operation) which produces an error number. This is then turned into a percentage change in fuelling to attempt to reduce the error to zero. The calculation uses the PID Prop Factor from the Lambda map in the following calculation.

$$\text{New Fuel \%} = \text{Old Fuel \%} + (\text{Lambda Error} \times \text{PID Prop Factor} / 1000)$$

This calculation does the bulk of the work.

To correct for minor errors that cannot be removed with the above the PID Integral Factor is used. Every time the Lambda value is measured then the errors are added up and the following calculation is used.

$$\text{Integral Error} = \text{Integral Error} + \text{latest Error}$$

$$\text{New Fuel \%} = \text{Old Fuel \%} + (\text{Lambda Integral Error} \times \text{PID Int Factor} / 1000)$$

To attempt to control rapid changes the differential factor is used in the following manner.

$$\text{Diff Error} = \text{Current Error} - \text{Last Error}$$

$$\text{New Fuel \%} = \text{Old Fuel \%} + (\text{Lambda Diff Error} \times \text{PID Diff Factor} / 1000)$$

The time between each set of the three calculations above is the sample delay. Any system takes a time to respond to any changes. There is no point in looking for the results of any changes until the system has responded fully. If you do there is a good chance that the control loop will oscillate. The S60 has a feature in the Lambda map which will perturb the fuelling by + and – 10% automatically allowing you to log the fuel pulse and the Lambda sensor with fast logging to determine how long the engine / exhaust / sensor takes to respond. The loop delay should be set for say 20% longer than this time.

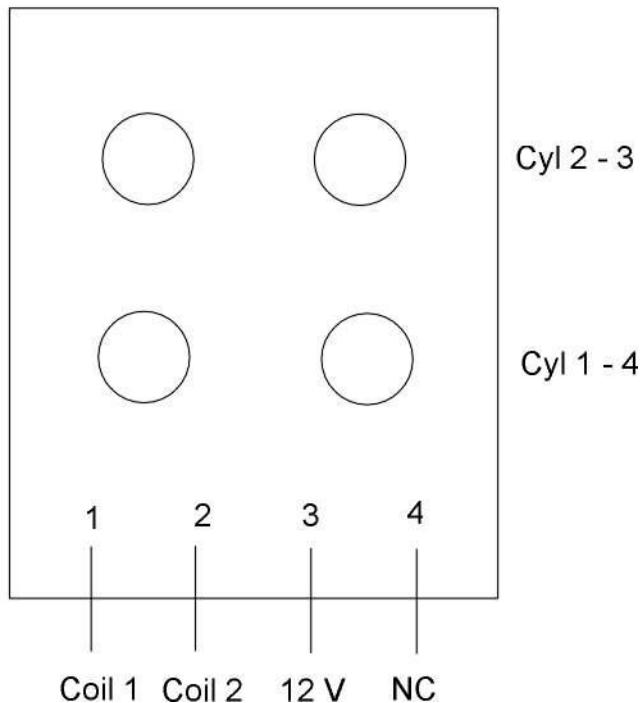
The following is a modified version of the Ziegler-Nichols guide to PID tuning dating from the 1940's.

- 1) Set the PID int factor and the PID diff factors to zero.
- 2) Increase the PID prop factor slowly until you get continuous oscillations.
- 3) Reduce the PID prop factor to half this value.
- 4) Try increasing the PID int factor slowly to reduce any error which will not reduce to zero.
- 5) Try small values of PID diff factor to improve stability and response.

If you cannot understand the above, try entering PID control into Google. There are various college primers on the subject out there.

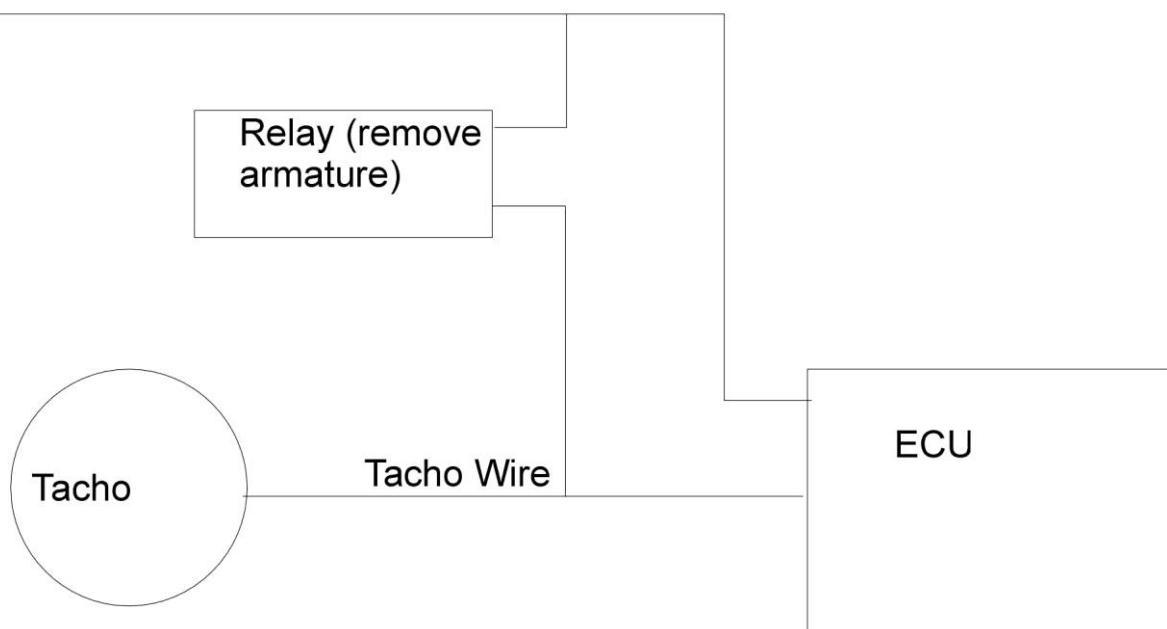
## DRAWINGS

### Valeo Coil Connections



### Distributor Substitute for Old Tacho

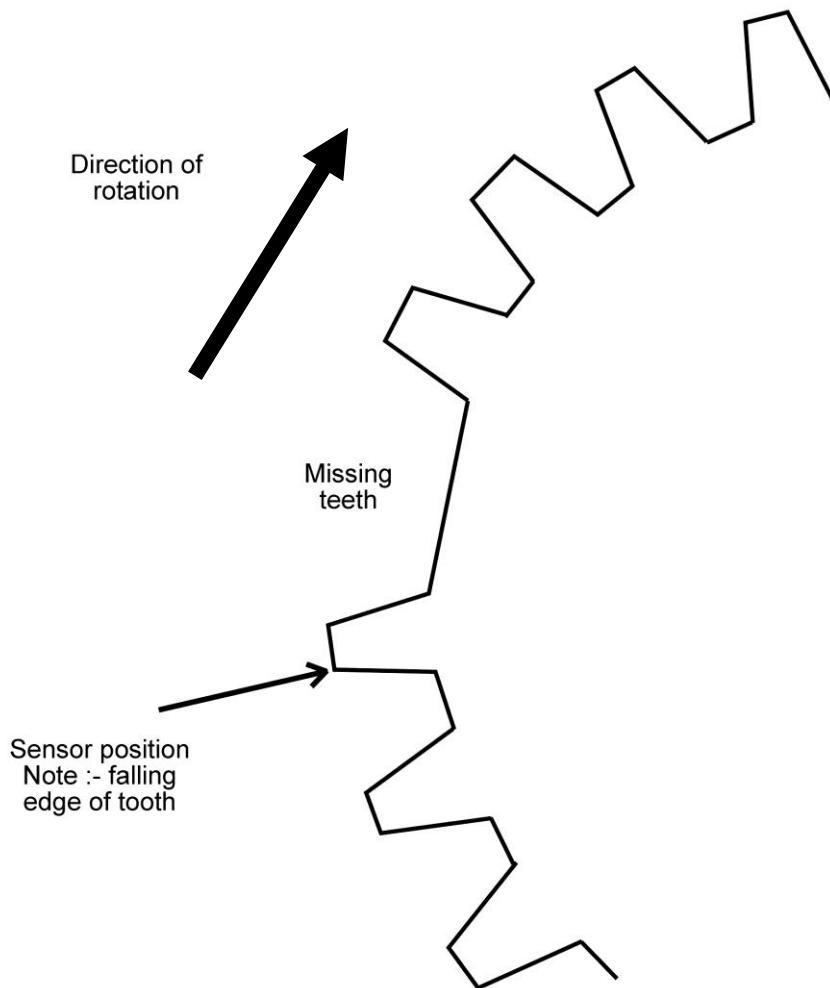
12v



## MULTI TOOTH CRANK WHEEL SENSOR POSITION

### SENSOR GAP

138MM DIA WHEEL GAP 0.5 TO 1.0 MM  
100MM WHEEL SENSOR GAP 0.25 TO 0.7 MM  
50MM WHEEL SESNOR GAP 0.1 TO 0.2 MM



To measure the correct angle for menu option 10 position the engine with the sensor opposite the first falling edge of the tooth following the missing tooth (as illustrated above). Mark the position. Turn the engine to exactly TDC number 1 cylinder. The number of degrees you have to turn the engine is the correct figure.

When the engine is running use a digital strobe light to measure the advance. Check this against the figure the system thinks it is using (say from dyno mode). If they do not agree make adjustments to the sensor position in option 10 until they do agree. This can be done whilst the engine is running.

Note also that unless you are using a specially modified strobe then the light will read twice the real advance when running distributor less i.e. if the strobe light says 50 degrees the real advance is 25 degrees!

This manual describes the wiring harness assembly Procedure of SUPER SEAL CONNECTORS.

**1. NAME / CAT. NO. OF APPLICABLE PRODUCTS**

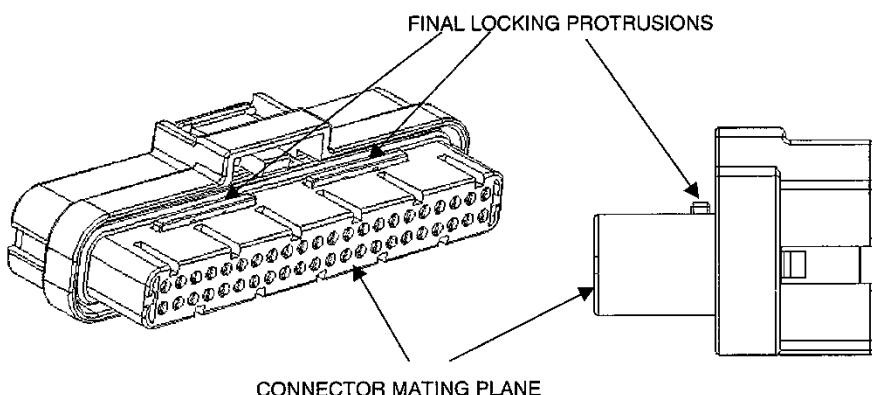
	Part Number	Old Part number
• Receptacle Contact ASS'Y	/ 3-1447221-3	3900187-01
	3-1447221-4	3900187-02
• Plug Housing ASS'Y	/ 2-1447232-6	3900281-441
	1376886-1	3900281-442
• Hole Plug	/ 4-1437284-3	3400130

**2. CONTACT CRIMPING**

- The contacts should be crimped in accordance with Crimping Specification 114-78011(Old PS-1191),114-78011-1(Old PS-1191-1).

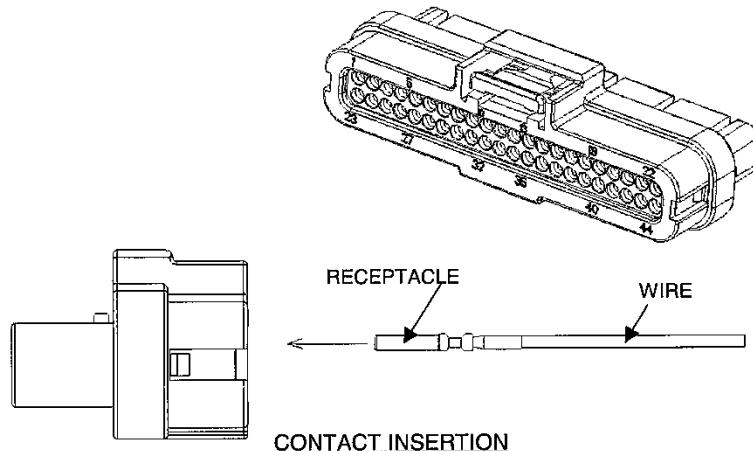
**3. CONTACT INSERTION**

- The contact should be protected from an unnatural external force so as not to be deformed or bent before it is inserted into the housing. (If the contact is deformed or bent, that contact should not be used and a new contact should be crimped.)
- It should be confirmed that two final locking "protrusions" of the housing protrude.

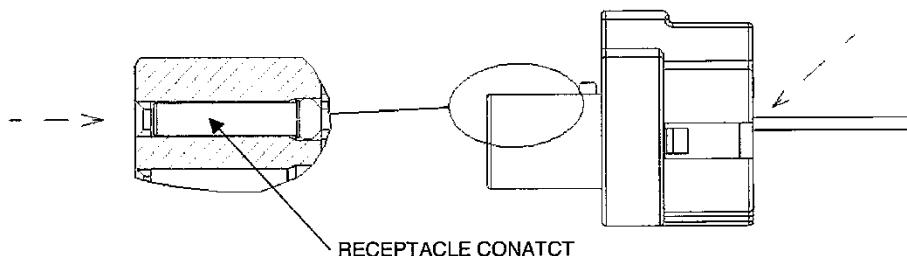


**HOUSING CONFIRMATION**

- As shown in the following figure, the contact should be held by the part near the crimping and inserted into the housing as vertically as possible.  
(The contact should be inserted as far as it hits the part of the housing to avoid the halfway insertion.)



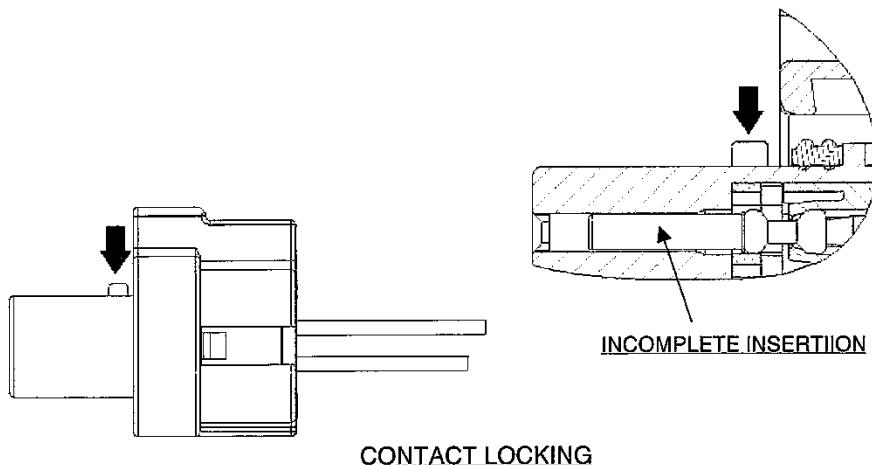
- It should be confirmed that the contact stays in a correct position from both the connectors mating plane and the contact insertion plane.
- If the contact is inserted into an incorrect position, the contact should be removed from the housing in accordance with the Sec. 5 of this manual and inserted again.



- When the insertion of the contacts is finished, it should be confirmed that the contacts are inserted into all the necessary positions. (The insertion of the hole plugs should be also checked.)

**4. FINAL LOCKING OF CONTACT**

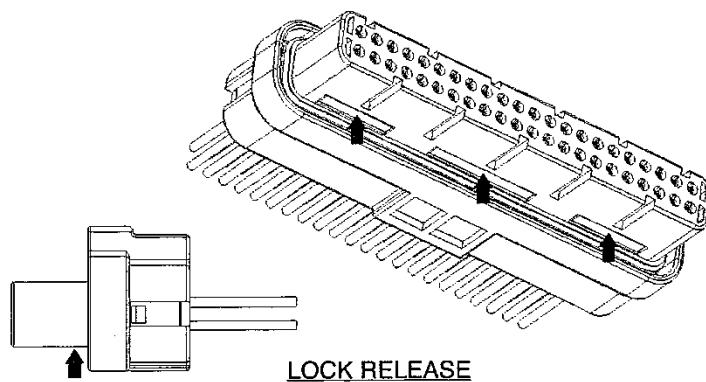
- After all the contacts are inserted, two final locking "protrusions" are pushed simultaneously into the housing by fingers for locking (latching feeling should be confirmed). If the nails are blocked halfway, it means that the halfway insertion of the contact is detected. In such case, therefore, it should be checked again whether the contact stays in the correct position or not without applying further pushing force.



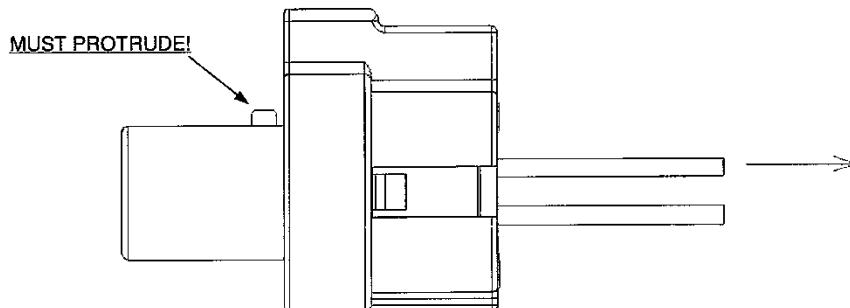
**INCOMPLETE INSERTION**

**5. CONTACT REMOVAL**

- If the final locking protrusions have already been pushed into the housing, the releasing side (one position) of the final lock is pushed up by a finger nail or a tool such as a minus driver. (Latching feeling should be confirmed. The release of the final lock should not be repeated more than 10 times.)



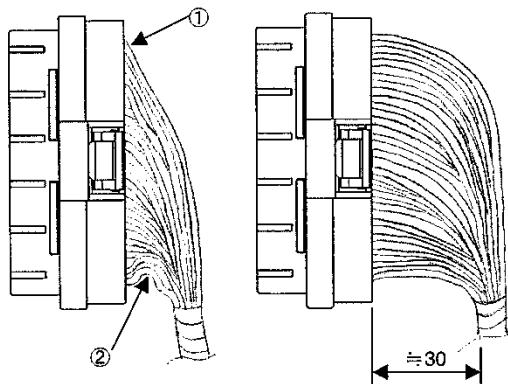
- If it is confirmed that both the final locking "protrusions" protrude, the wire crimped with the contact to be removed is drawn out as vertically as to the housing. (The removal of one position should not be repeated more than 3 times.)



#### CONTACT REMOVAL

#### **6. OTHERS**

- When the wires are bundled (by taping, etc.), care should be taken not to apply a tensile force to one arbitrary wire.
- If the wires are bent approximately 90 degrees, the bent position should be approximately 20mm apart from the connector and the bending form, the bundling position, etc. should be considered.
  - ① in order not to apply a tensile force to the wire outside the bend.
  - ② In order not to apply a compression load to the wire inside the bend and deform the wire.
- The housing should not be dismantled.



#### BEND OF WIRES

- The housing should not be dismantled.

## Version Control

Vers.	Date	Description	Author
10	01/02/2016	Initial Version Control.	AC
10.1	12/02/2016	Added CAN data for V79.04	AC