

# **OMEM 710**

## Hardware Instructions OMEM710 v052 – v055

<b>1</b>	<b>Introducing Omex Engine Management .....</b>	<b>5</b>
1.1	Notation Used in This Manual .....	5
<b>2</b>	<b>Quick Start .....</b>	<b>6</b>
<b>3</b>	<b>Inputs and Outputs.....</b>	<b>8</b>
<b>4</b>	<b>Sensors .....</b>	<b>13</b>
4.1	Crank Sensor .....	13
4.2	Cam1 Sensor .....	15
4.3	Cam2 Sensor .....	16
4.4	Throttle Position Sensor .....	17
4.5	MAP Sensor .....	17
4.6	MAF Sensor .....	18
4.7	Coolant Temp Sensor .....	18
4.8	Air Temperature Sensor .....	19
4.9	Barometric Pressure.....	20
4.10	Road Speed Sensor .....	20
<b>5</b>	<b>Map axes .....</b>	<b>22</b>
<b>6</b>	<b>Fuelling.....</b>	<b>23</b>
6.1	Battery Voltage Compensation.....	24
<b>7</b>	<b>Rev Limits .....</b>	<b>27</b>
<b>8</b>	<b>Dashboard.....</b>	<b>28</b>
<b>9</b>	<b>Engine Start Condition.....</b>	<b>29</b>
9.1	Ignition.....	29
9.2	Fuel .....	29

**10 Idle Strategies ..... 30**

    10.1 Scatter Spark Idle ..... 30

    10.2 Air Bypass Idle ..... 31

    10.3 High Idle ..... 31

    10.4 Air Con Idle..... 32

**11 Transient Conditions..... 33**

    11.1 Acceleration Fuel ..... 33

    11.2 Deceleration Fuel Cut Off..... 34

**12 Correction Factors..... 35**

    12.1 Coolant Temperature ..... 35

    12.2 Air Temperature ..... 35

    12.3 Barometric Pressure..... 35

    12.4 Individual Fuel Output Trims..... 36

**13 Oxygen Feedback..... 37**

    13.1 Narrowband..... 37

    13.2 Wideband ..... 39

**14 Cooling Fans..... 40**

**15 Knock Control..... 41**

**16 Full Throttle Gearshift ..... 43**

**17 Staged Injectors..... 44**

    17.1 Twin Injectors ..... 44

    17.2 Staged Injectors ..... 44

**18 VTEC Cam Control..... 45**

**19 VVC Cam Control..... 46**

<b>20</b>	<b>Traction Control</b> .....	<b>47</b>
<b>21</b>	<b>Rev Limits</b> .....	<b>48</b>
<b>22</b>	<b>Turbo Boost Control</b> .....	<b>49</b>
<b>23</b>	<b>Anti-lag</b> .....	<b>50</b>
<b>24</b>	<b>Alt Function</b> .....	<b>51</b>
<b>25</b>	<b>User1</b> .....	<b>52</b>
<b>26</b>	<b>Internal Data Logging</b> .....	<b>53</b>
<b>27</b>	<b>Synchronisation</b> .....	<b>55</b>
<b>28</b>	<b>Dwell Control</b> .....	<b>56</b>
<b>29</b>	<b>Security</b> .....	<b>57</b>
<b>30</b>	<b>Wiring</b> .....	<b>59</b>
	30.1 Semi Assembled Loom Construction .....	59
	30.2 ECU Connector Pins .....	60
	30.3 Component Pin-outs.....	61
	30.4 Diagrams.....	62

# 1 Introducing Omex Engine Management

Thank you for choosing Omex Engine Management. This manual is written to help the user through the specifics of the OMEM710 ECU. **It is essential that the user reads all of the Omex manuals before attempting to install the system and before attempting to start the engine.** Incorrect use of the Omex system could potentially lead to damage to the engine and personal injury. If you have any doubts about fitting these parts or using the software then please contact Omex for help.

As the system is computer based, technical support is given on the assumption that the user is able to perform simple Windows based operations. The user will also need access to email as Omex will nearly always require a copy of the map in the ECU to give support.

Omex may not be held responsible for damage caused through following these instructions, technical, or editorial errors or omissions. If you have any doubts about fitting these parts or using the software then please contact Omex for help.

## 1.1 Notation Used in This Manual

Menu commands are signified in bold type with a pipe symbol | between each level of the menu.

For example, **File | Open** indicates that you should click on the **Open** option in the **File** menu.

**UPPER CASE TEXT** is used to indicate text that should be typed in by the user.

## 2 Quick Start

**It is not possible to start a new calibration from File | New. Please contact Omex for a suitable start-up map.** There are many options and tables that need to be set in the background and are not covered by this manual, and many that are not accessible by the user.

The following is a guide to starting your engine after ECU installation to ensure all is working before taking it to be mapped.

### Wiring

Wire your semi-assembled harness or ready-built harness as shown in the Wiring section of this manual.

### Trigger Wheel

If installing a trigger wheel of missing tooth type,


- Accurately mark TDC.
- Turn the engine to approximately 90° BTDC.
- Mount your crank position sensor (CPS) anywhere around the perimeter of the timing wheel pointing towards the centre of the wheel with a sensor to wheel gap of approximately 0.5mm.
- Mount the trigger wheel with the missing tooth pointing at the sensor.

If machining a trigger pattern into the front pulley then it is usually easiest to machine all of the teeth in, mount the front pulley, and then remove the tooth pointing at the sensor at 90° BTDC.

### Software

- Install the MAP3000 software by inserting disk 1 into the floppy drive and following the on-screen instructions.
- Save the start-up map from the start-up disk to the hard-drive in the location c:\program files\map3000\calibrations.
- Open MAP3000 from the 'Start bar'
- Join the data lead between the ECU and the PC's COM port
- **ECU | Send new calibration**
- Ignition ON (do not crank the engine)
- Select your start-up map and press 'open'
- When the calibration has been sent to the ECU cycle ignition power OFF / ON

### Throttle position

- Press the start button 
- The Parameters window shows a number for **TPS raw**. At the idle position, the throttle pot needs to be physically turned until this number is around 20. Tighten the throttle pot then open to WOT (wide open throttle) and check the **TPS raw** number. This number should be less than 255. If the number is 255, then the throttle pot is at its stop so needs to be turned back until it reads less than 255.
- The number for **TPS raw** at WOT needs to be inputted to the options box as **TPS max**. The number for **TPS raw** at idle needs inputting to the options box as **TPS min**.

### Sensor Test


The parameters window shows all of the sensor inputs. Check that these are all showing sensible numbers.

### Injector Scaling

When attempting to start the engine for the first time you may need to change the injector scaling as the fuel requirements, injector flowrates, and fuel pressure vary between engines. The option **Microsec/bit** is a linear scaling factor. A higher number is more fuel, a lower number is less.

## Ignition Timing

The ECU recognises the engine position by a missing or extra tooth on a pattern of evenly spaced teeth or by a pattern of cam teeth. Different manufacturers have this reference in a different place on the trigger wheel so the ECU needs to have adjustment for this. The numbers are known for most manufacturers and will be set in the start-up map but if they are unknown or if you are using an Omex external 36-1 wheel, you will need to find this value yourself. To find this value you will need a strobe light and an accurate TDC mark on the engine.

- Press the start button 
- Attempt to start the engine. The ignition timing may be wrong by a large amount so it may not start. If the engine will not start you will need to alter the option **Timing Alignment** until it does. Changes of 1 in **Timing Alignment** are changes of 30 crank degrees.
- Hold the engine at 2000-3000 rpm (ie out of the idle condition to where the ignition timing is stable)
- Check the engine speed shown on the strobe light. Some strobe lights will see the wasted spark on DIS systems and so will show double engine speed and so also double ignition timing. If this is the case then halve all ignition timing figures shown on the strobe light.
- Check the ignition timing with a strobe light and compare this number to the number in the parameter **Spark Total**.
- If the strobe light shows an ignition timing number lower than the ECU then decrease the value of option **Timing Alignment**. If the strobe light shows a number higher than the ECU then increase the value of option **Timing Alignment**. **Timing alignment** is measured in internal units - a change of 1 is a change of 30 crank degrees so user changes to **Timing Alignment** should be very small. The value for **Spark Total** on the PC will not change, but the timing mark on the engine will move, so each adjustment will require the strobe light resetting. Repeat these changes until the strobe light timing figure agrees with the timing figure shown by **Spark Total**.

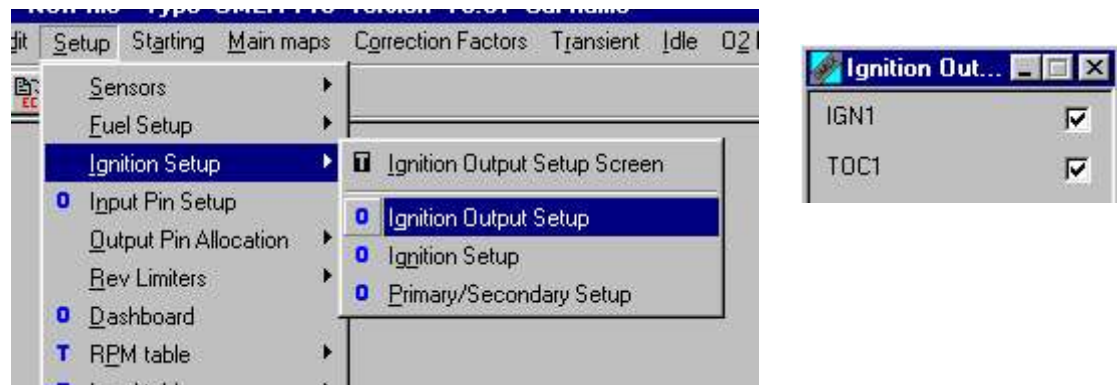
### 3 Inputs and Outputs

The physical input and output pins for each function are in some cases fixed (eg Coolant Temperature sensor must always be on the same physical pin) but many are selectable. The physical pins have names based on their normal output type, but the names do not necessarily tell the user what they are being used as. The wiring section of the manual gives suggested pin-outs for most engines but some will need to be decided by the user. If you are in any doubt then please contact Omex. The ECU needs to be told which pins are being used for which functions.

#### Coil outputs

Coils may be controlled on any of the IGN pins. To set an IGN pin as a coil driver it must have the **IGNx** and **TOCx** checked.

If using primary / secondary ignition (normally for rotary engines), the coils may be set to either the primary or secondary spark. Please contact Omex if you wish to use this function.



Engines with different numbers of cylinders and different numbers of coils will need the ignition outputs firing coils at different intervals. The ECU needs to be told what these intervals are. This is done in **Setup | Ignition Setup | Ignition Setup** and will be preset in start-up maps.

As the external reference point (missing or extra tooth or cam tooth) on a crank trigger wheel varies rotationally between manufacturers and between individual's installations of trigger disks, the ECU needs to be told where this reference point is. The option **Timing Alignment** describes the overall timing alignment adjustment and can be adjusted to suit each trigger wheel type. See the 'Quick Start' section for a description of how to do this.

**Coil Dwell factor** is a multiple in the equations which ultimately lead to the coil dwell time. A typical modern coil requires a value of **20**. Increasing this number can lead to failure of the ECU ignition output drivers.

The ECU uses an internal counter of 12 markers, known as teeth, per crank revolution. **Ignition Cycle Teeth** is the number of internal teeth in one ignition cycle.

generally;

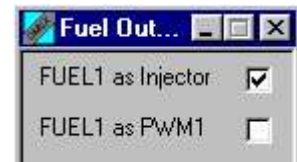
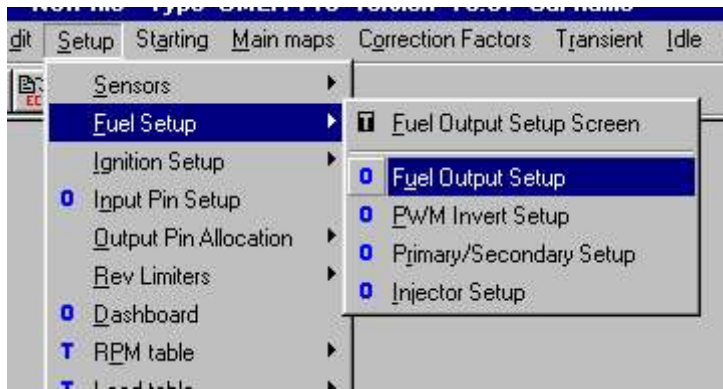
DIS (wasted spark, distributorless) **12**

Coil-per-plug **24**

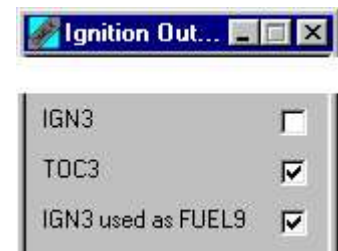
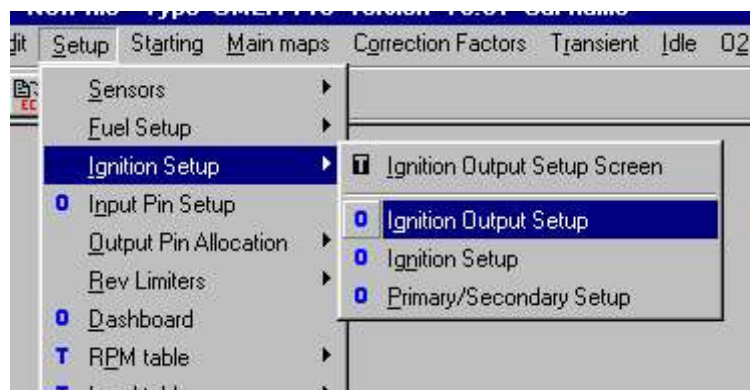
#### Injector outputs

Injectors may be controlled by any of the FUEL pins and IGN3, IGN4, IGN5, or IGN6.

To set a FUEL pin as an injector driver it must have the **FUELx as injector** checked and **FUELx as PWM NOT** checked.



To set IGN3, IGN4, IGN5, or IGN6 pin as an injector driver they must have the **TOCx** and **IGNx as FUELx** checked. **IGNx** must NOT be checked.



Engines with different numbers of cylinders and different numbers of injectors will need the fuel outputs firing coils at different intervals. The ECU needs to be told what these intervals are. This is done in **Setup | Fuel Setup | Injector Setup** and will be preset in start-up maps.

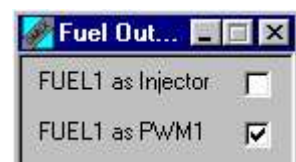
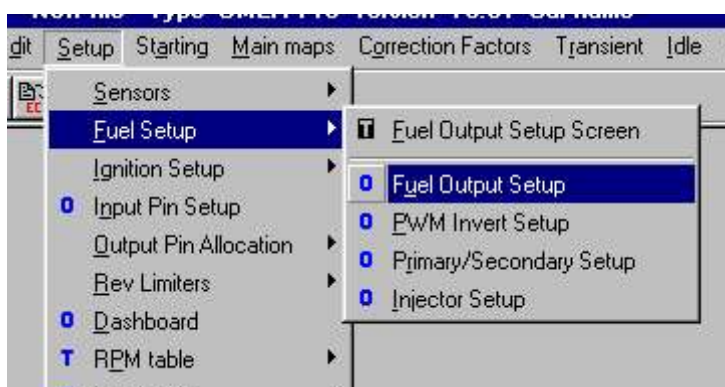
As the external reference point (missing or extra tooth or cam tooth) on a crank trigger wheel varies rotationally between manufacturers and between individual's installations of trigger disks, the ECU needs to be told where this reference point is. The option **Fuel Sync** describes the overall injection start point timing adjustment. A value change of 1 is a start point movement of 30 degrees. This should be adjusted until the idle emissions are at their best.

The ECU uses an internal counter of 12 markers, known as teeth, per crank revolution. **Fuel Cycle Teeth** is the number of internal teeth in one injection cycle.

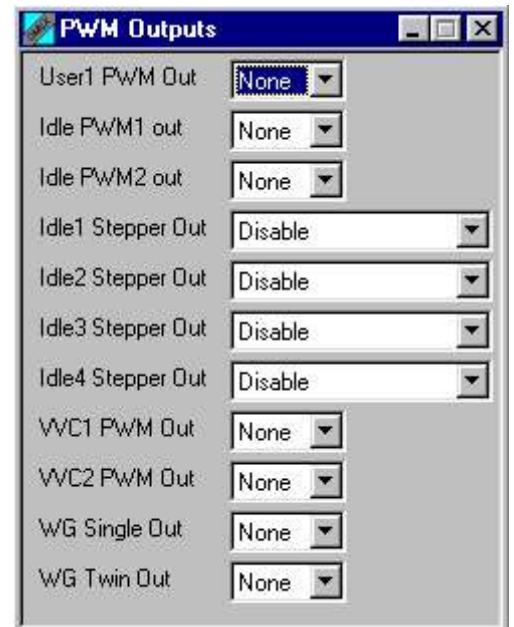
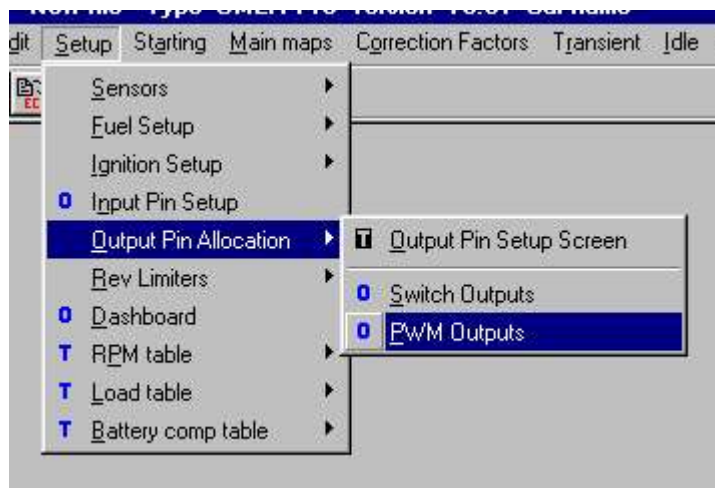
- generally;
- Semi Sequential **12**
- Sequential **24**

### PWM Device outputs

PWM devices (such as idle motors, boost solenoids etc) may be controlled by any of the FUEL pins. To set a FUEL pin as a PWM driver it must have the **FUELx as PWMx** checked and **FUELx as injector** NOT checked.

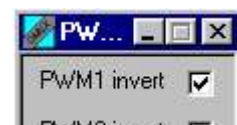
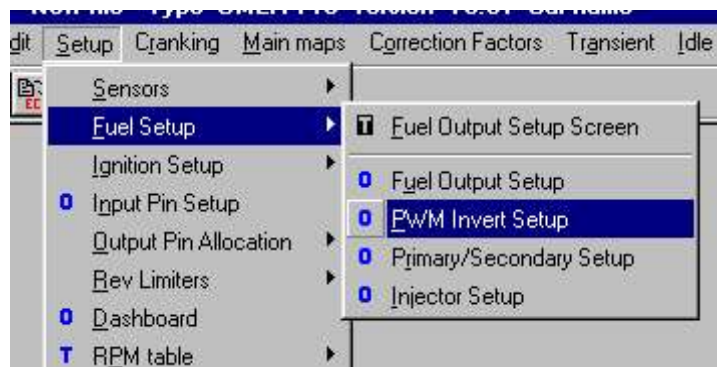


Controls are then applied to these activated PWM outputs using the **Setup | Output Pin Allocation | PWM Outputs** options group.



The options group shows stepper motor options. Please contact Omex if you plan to use a stepper motor.

The PWM outputs will usually require inverting.



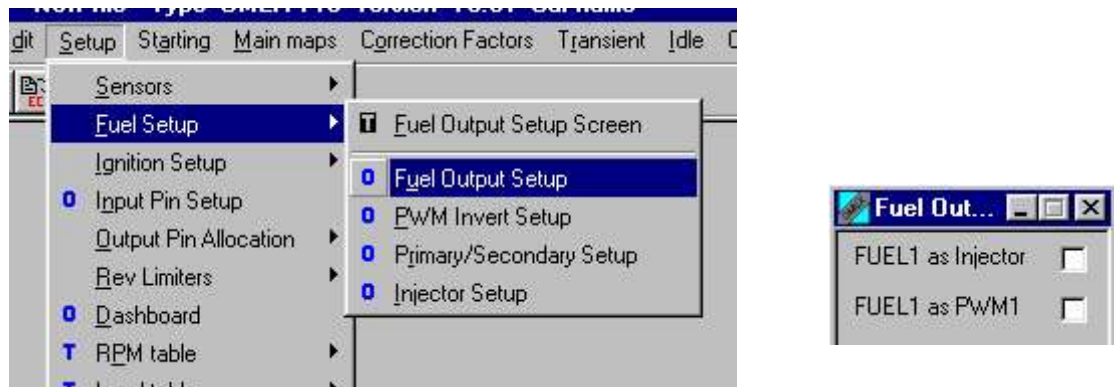
### Switch outputs

Switch outputs may be controlled by IGN pins, FUEL pins, or HIGHSIDE pins.

To set an IGN pin as a switch output it must have both the **IGNx** and **TOCx** NOT checked.

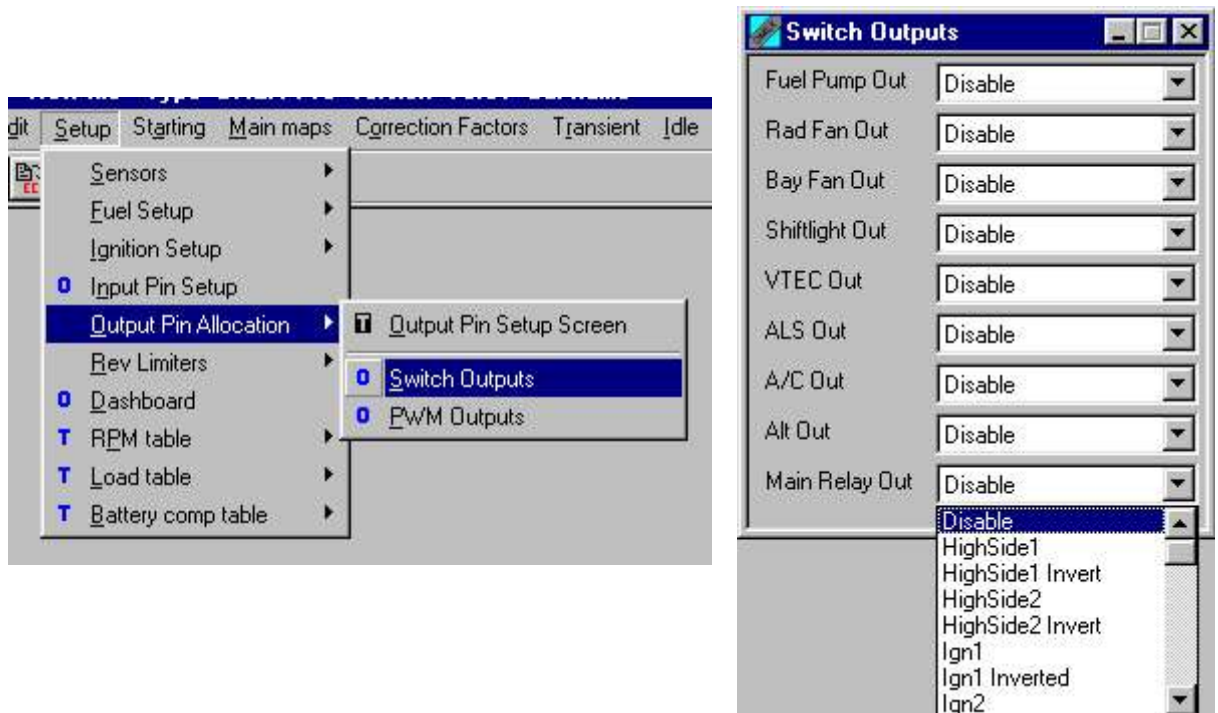


To set a FUEL pin as a switch output it must have both the **FUELx** and **PWMx** NOT checked.



The HIGHSIDE pins are switch pins only so do not need the hardware switching to this output type.

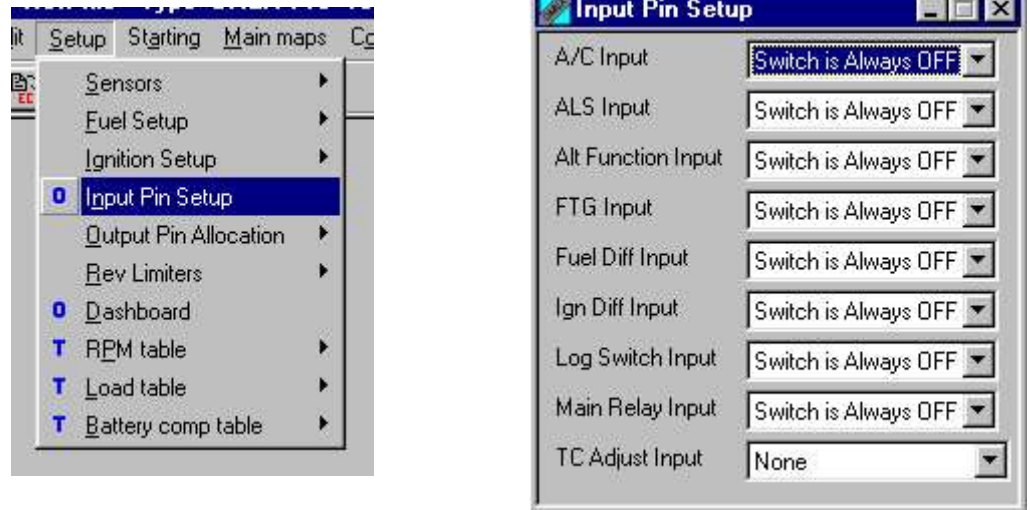
Controls are then applied to these switch outputs using the **Setup | Output Pin Allocation | Switch Outputs** drop-down options group.



If the output needs to work in reverse (ie the output going OFF when the software function goes ON) then use the **inverted** option version.

There are also options of N.U., tacho and tele. Do not use these unless instructed to do so by Omex.

## Switch inputs



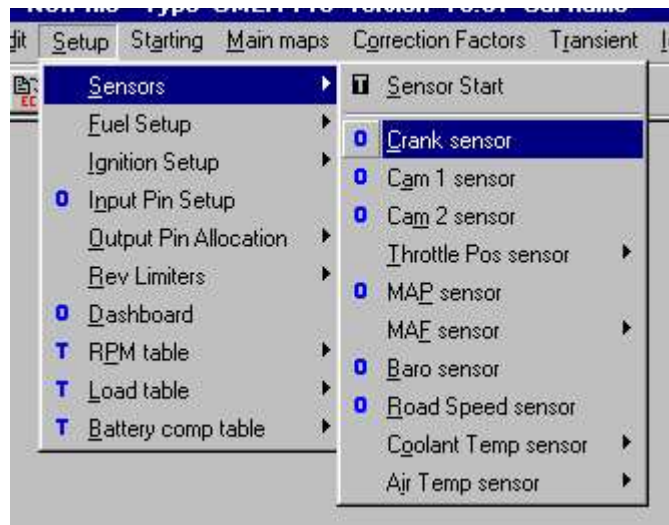
Switch input pins are selected using the drop-down options. A switch input function can have any of the input pins on the list assigned to it so long as they are not being used already by sensors. (eg. If an oxygen sensor is being used on pin OX1, a switch clearly cannot be assigned to this pin). For a function to be active always without a physical switch to turn it on (sometimes this is the case with the Alt Function) select **Switch is Always ON**.

## TC Adjust input

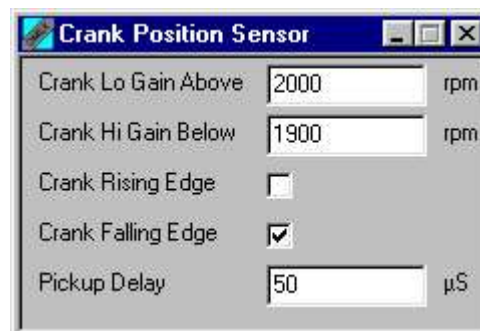
The **TC Adjust Input** is selected in the same options group as the switch inputs. Some of the selectable pins cannot be used as they are always covered by other inputs. The following pins may be used if they are not covered by other inputs – Cam#1 Voltage (CAM), Cam#2 Voltage (FUEL7), Knock in Voltage (KNOCK), MAP1, MAP2, Oxygen1, Oxygen2.

## 4 Sensors

### 4.1 Crank Sensor



The ECU needs to know engine speed and position in order to supply the correct fuelling and ignition timing. This is often achieved using the standard sensors, but can involve putting new sensors on the engine. Engine speed is typically measured using a pattern of teeth on the crank (known as a trigger wheel).



The crank sensor input can be from either a Magnetic Variable Reluctance (VR) sensor or a Hall Effect sensor. The two types of sensor require different hardware on the ECU board, so are selected by physical jumpers. See jumpers section.

- Crank Lo Gain Above** Some VR crank sensors give too high an output at high engine speeds. This feature allows the sensitivity of the ECU to be switched to lower above the set engine speed to allow for this. Typically 1500rpm.
- Crank Hi Gain Below** High channel sensitivity when below this value. Should be set below the on value (hysteresis). Logic level sensors (hall effect) set to 0
- Crank Rising Edge** rising edge of the crank signal is used as the significant edge if ON. Typically **OFF**
- Crank Falling Edge** falling edge of the crank signal is used as the significant edge if ON. Typically **ON**
- Pickup Delay** used to compensate for the systems timing pickup and ignition coil delays. Typical value 50

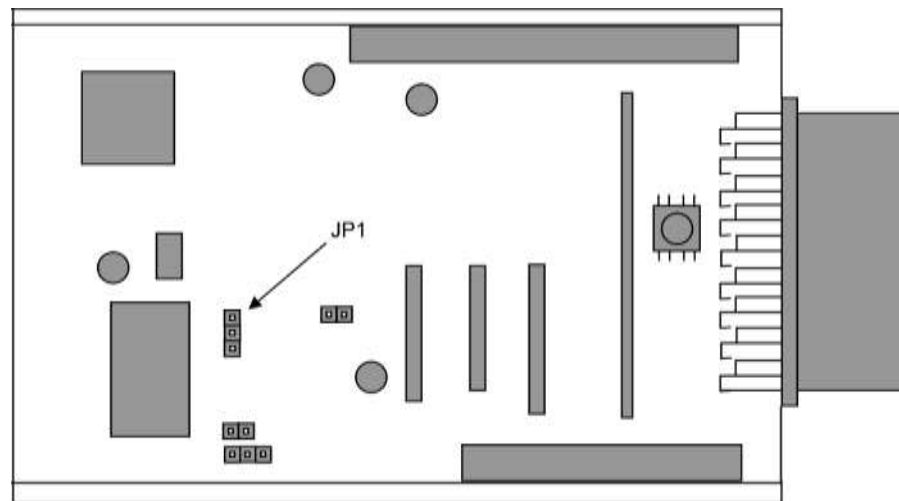
## Trigger Wheels

Many older engines do not have a trigger wheel. If this is the case an external wheel must be fitted. Contact Omex for suggested trigger patterns. There is a minimum diameter for these wheels dependent on the sensor used, the trigger pattern, and the engine operating speeds. Contact Omex for advice. The wheel needs to be mounted on the front pulley. It may also be possible to machine this pattern into the front pulley wheel, remembering that the pattern must be in a ferrous material for the sensor to work. Omex can supply general purpose trigger wheels in diameters of 100mm and 140mm.

If installing a trigger wheel of missing tooth type, see the quickstart section for guidance.

## Jumpers

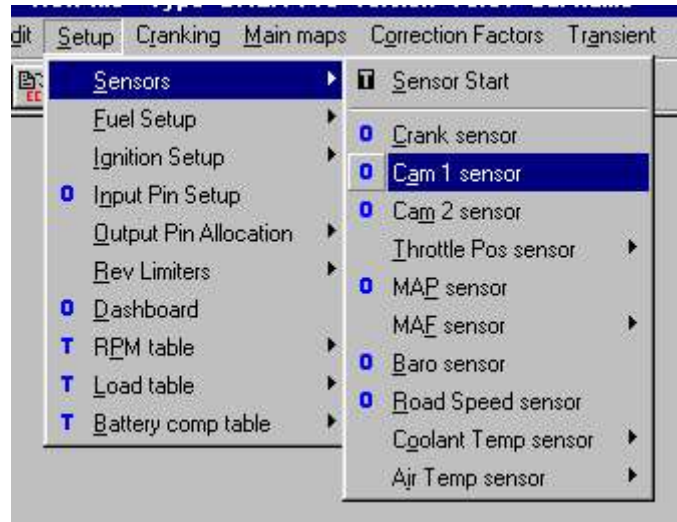
To allow for different input ranges of the crank sensors, physical jumpers need to be set. The following diagram shows an aerial view of the ECU board with the main wiring connector on the right-hand side.



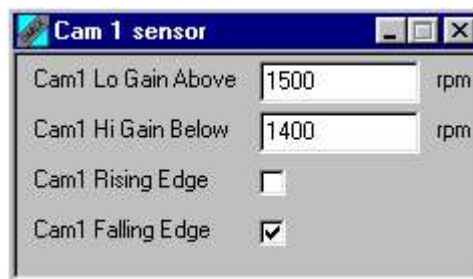
### Crank sensor (JP1)

Sensor Type	Jumper Position	
Typical MVR	none	
High Output MVR	1 2	
Hall Effect	2 3	

## 4.2 Cam1 Sensor

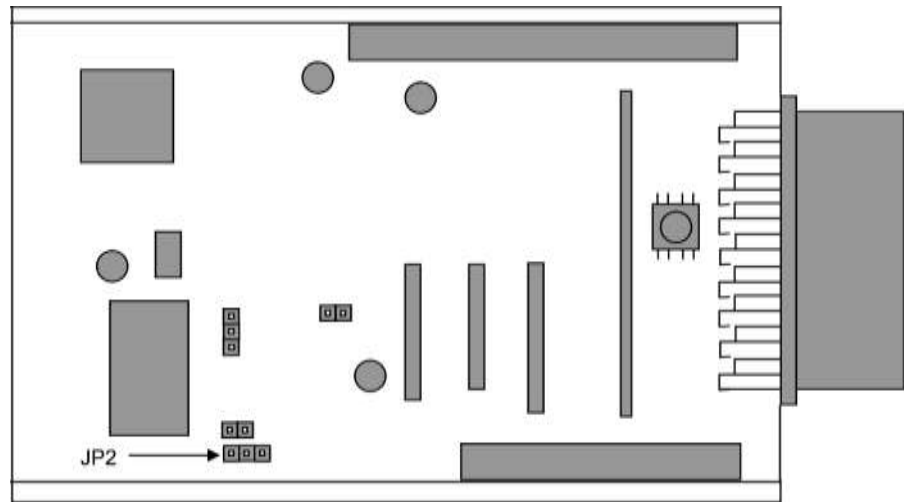


If an engine is to control the injectors sequentially or ignition coil-per-plug, it needs information about what part of the engine cycle it is in (there are two crank revolutions per engine cycle for a 4 stroke engine, but only 1 cam revolution). The cam sensor provides this information.



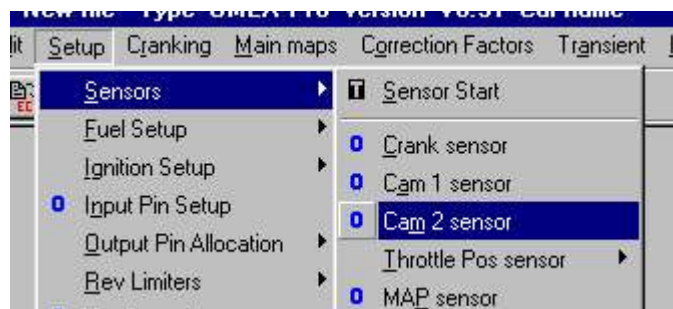
- Crank Lo Gain Above** Some VR crank sensors give too high an output at high engine speeds. This feature allows the sensitivity of the ECU to be switched to lower above the set engine speed to allow for this. Typically 1500rpm.
- Crank Hi Gain Below** High channel sensitivity when below this value. Should be set below the on value (hysteresis). Logic level sensors (hall effect) set to 0
- Crank Rising Edge** rising edge of the crank signal is used as the significant edge if ON. Typically **OFF**
- Crank Falling Edge** falling edge of the crank signal is used as the significant edge if ON. Typically **ON**

The cam input can be from either a MVR or Hall sensor. Jumpers on the board must be set to allow for these two sensor types.

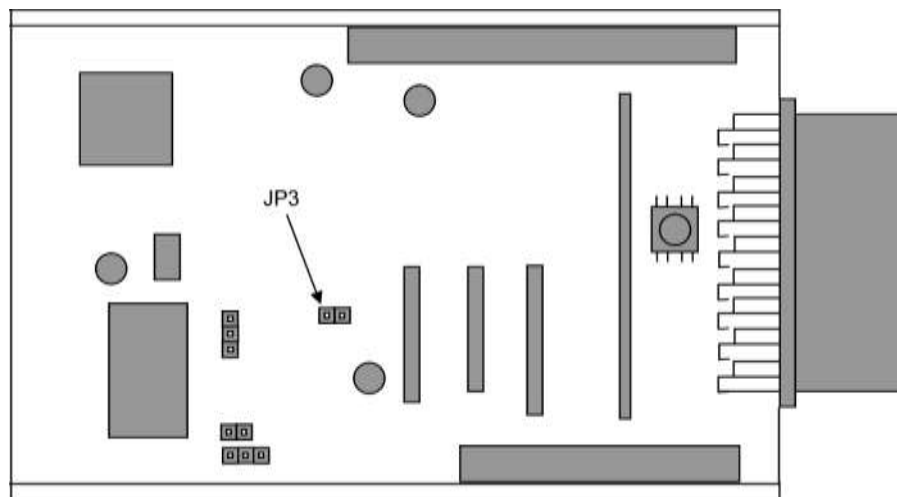


Sensor Type	Jumper Position	
Typical MVR	none	
High Output MVR	1 2	
Hall Effect	2 3	

### 4.3 Cam2 Sensor



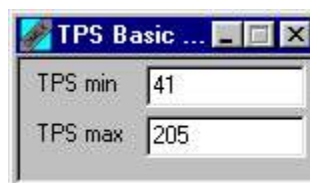
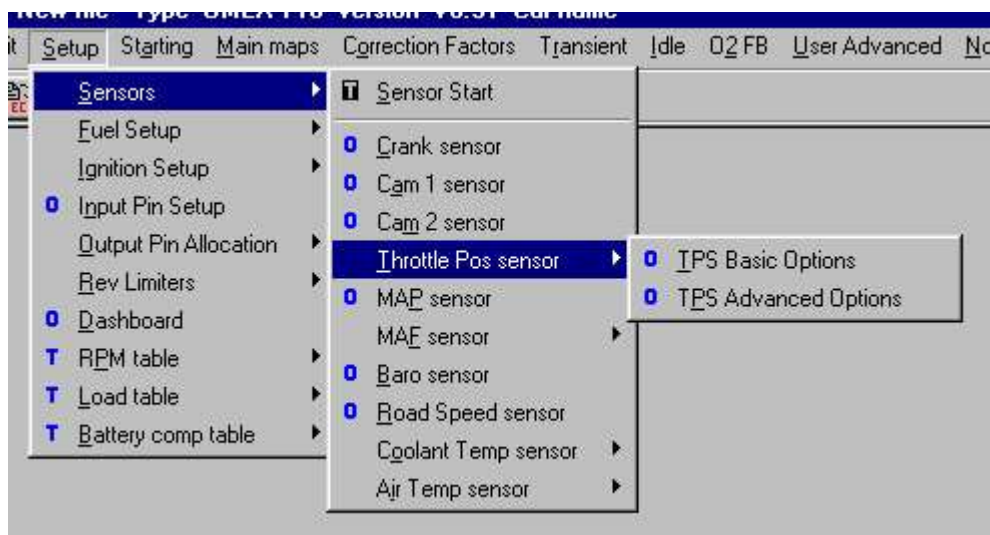
The Cam2 sensor is used for some engines, typically V engines using VVC.



Sensor Type	Jumper Position
Typical MVR	OFF
Hall Effect	ON

#### 4.4 Throttle Position Sensor

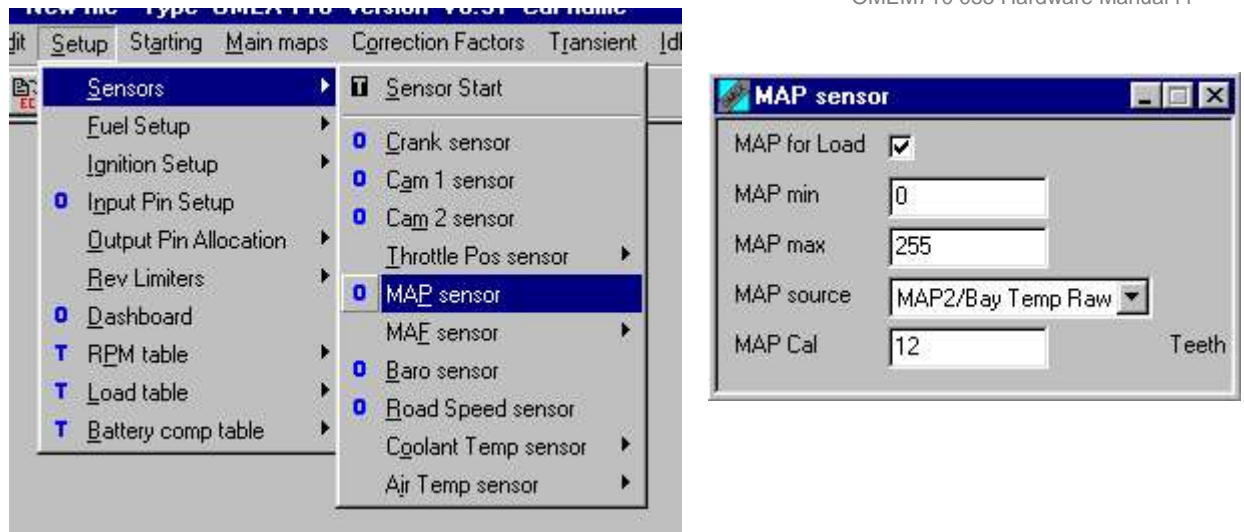
The ECU needs an input of engine load. The Omex ECU can use an input of throttle position (TPS), manifold absolute pressure (MAP), or mass air flow (MAF). Most normally aspirated engines will use an input of throttle position as this gives excellent throttle response. Forced induction engines need to use MAP or MAF as there is no direct relationship between throttle angle and engine load due to the variable of boost pressure. However, forced induction still requires throttle position sensor (TPS) input for idle condition information and possibly acceleration / deceleration fuelling.



The parameter **TPS raw** gives the raw number output of the sensor which is scaled by options **TPS min** and **TPS max** to give a throttle that works between 0 and 100. To calibrate, see Quick Start section of this manual.

#### 4.5 MAP Sensor

The ECU needs an input of engine load. The Omex ECU can use an input of throttle position (TPS), manifold absolute pressure (MAP), or mass air flow (MAF). Most normally aspirated engines will use an input of throttle position as this gives excellent throttle response. Forced induction engines need to use MAP or MAF as there is no direct relationship between throttle angle and engine load due to the variable of boost pressure. However, forced induction still requires throttle position sensor (TPS) input for idle condition information and possibly acceleration / deceleration fuelling.



An external three wire 0 - 5 V output MAP sensor can be used to sense engine load. MAP sensor ratings are absolute rather than boost pressure so 1bar is for normally aspirated (NA) non-boosted engines and barometric compensation, 2bar for up to 1bar boost, 2.5bar for up to 1.5bar boost, and 3bar for up to 2bar boost. The 710 ECU has an in-built 1bar sensor that may be used for either engine load or barometric correction.

If you are using MAP for load then set **MAP for Load ON**.

**MAP min** and **MAP max** will only need changing from **1** and **255** if you are using an oversized MAP sensor. If this is the case then contact Omex for advice.

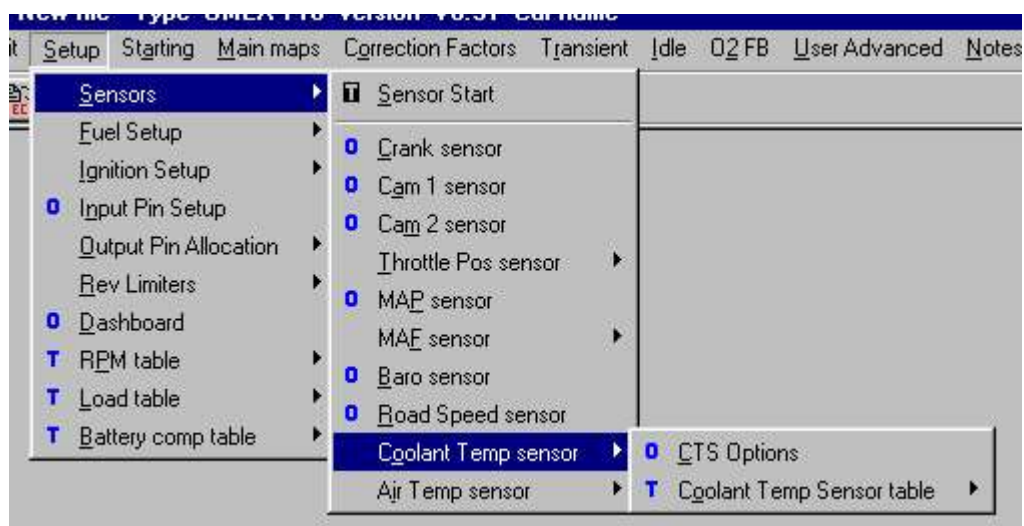
**MAP source** is the input pin for the MAP Sensor. This would nearly always be **MAP2**.

**MAP Cal** time over which the ECU averages the MAP input measured in internal units. Typically 12

#### 4.6 MAF Sensor

Contact Omex if you would like to use MAF as the main load sensor.

#### 4.7 Coolant Temp Sensor

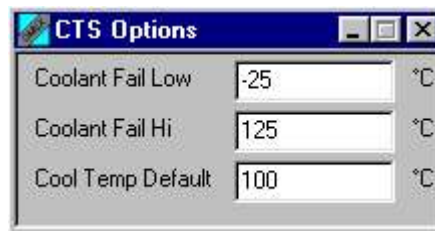


The coolant temperature sensor (CTS) is required to give the ECU information on the temperature of the engine's coolant, allowing the user to set up correction factors for cold starting and running.

The coolant temperature sensor used by the Omex ECU is a resistive sensor. The raw output of this sensor is calibrated in the ECU to give the information in a more usable form, °C. Sensors are calibrated in the **Coolant Temp Sensor table**. The values for many sensors are known (Omex sensor shown below) but you may need to calibrate your sensors. It is essential that these sensors are calibrated correctly as many functions are temperature based.

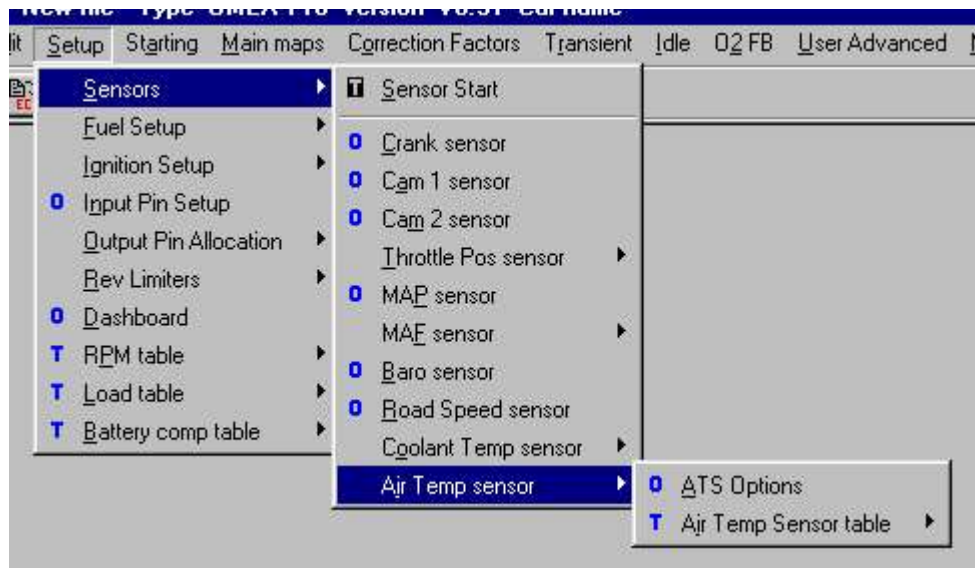
To calibrate a sensor;

- **ECU | Connect**
- Power on
- **Setup | Sensors | Coolant Temp Sensor | Coolant Temp Sensor table | Table view**
- Place the sensor and a thermometer in a kettle or pan of water
- The ECU will highlight the current raw input value from the sensor. Above this input value, enter the current thermometer reading in degrees centigrade.
- Heat the water. As the temperature increases, repeat the temperature readings.
- When the water is fully heated, repeat the process as the water cools
- Using the graph view, smooth the curve to remove any mistakes, and extrapolate to unobtainable temperatures.



**Coolant Fail Low** and **Hi** are the failure points of the sensors. Example- If the minimum readable temperature of a sensor is -25 then **Coolant Fail Low** should be set at -24. If the maximum readable temperature of the sensor is 125 then **Coolant Fail Hi** should be set to 124. **Coolant Temp Default** is the temperature to which the input defaults if the sensor goes into failure.

## 4.8 Air Temperature Sensor

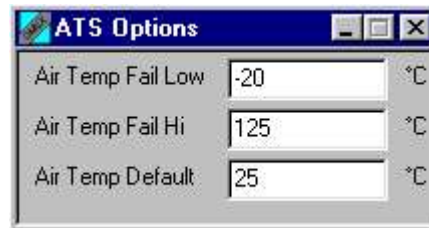


The air temperature sensor (ATS) is used to give the ECU information on the temperature of the inlet air. This allows the user to make corrections to the fuelling and ignition timing based on inlet air

temperature. The air temperature should be measured as close to the inlet as possible, preferably in the inlet airbox, or with forced induction engines, in the inlet plenum.

The air temperature sensor used by the Omex ECU is a resistive sensor. The raw output of this sensor is calibrated in the ECU to give the information in a more usable form, °C. Sensors are calibrated in the **Coolant Temp Sensor table**. The values for many sensors are known but you may need to calibrate your sensors. It is essential that these sensors are calibrated correctly as many functions are temperature based.

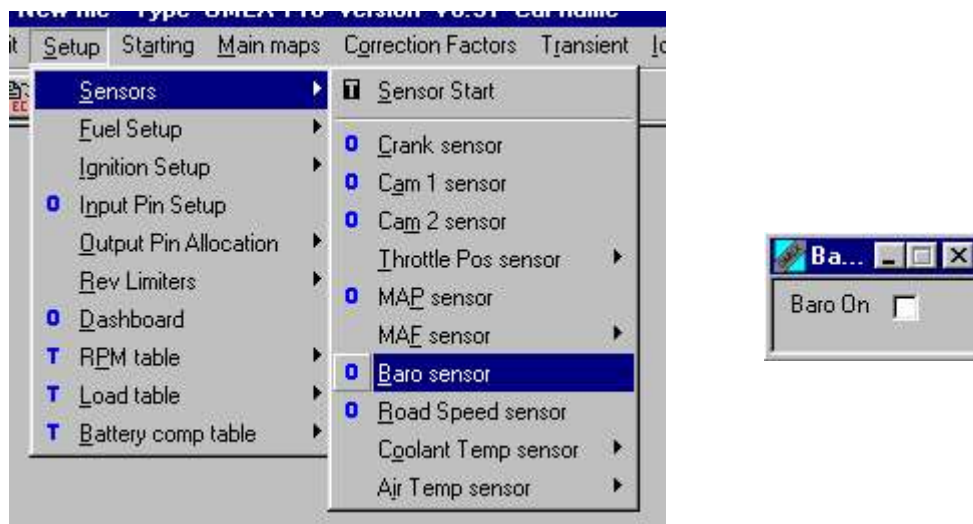
To calibrate your sensor, see the calibration of the coolant temperature sensor.



**Air Temp Fail Low** and **Hi** are the failure points of the sensors. Example- If the minimum readable temperature of a sensor is -25 then **Air Temp Fail Low** should be set at -24. If the maximum readable temperature of the sensor is 125 then **Air Temp Fail Hi** should be set to 124. **Air Temp Default** is the temperature to which the input defaults if the sensor goes into failure.

#### 4.9 Barometric Pressure

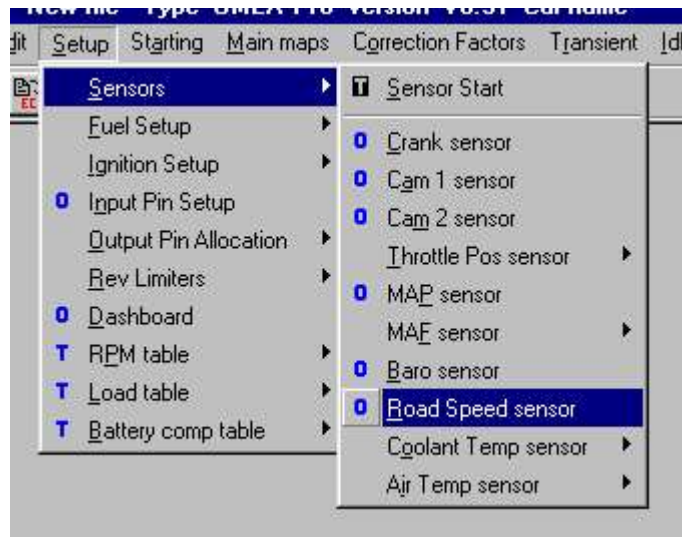
As the air pressure changes, so does the amount of oxygen per volume of air. Changes in most countries are relatively little, but if driving in large mountain ranges such as the Andies, these changes can be significant. The 710 ECU has an in-built 1bar MAP sensor which may be used for barometric correction.



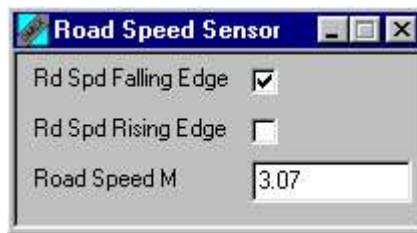
As the 710 has an inbuilt sensor, no calibration is required, the function is simply enabled or disabled. **Baro** must NOT be checked if using the internal sensor for load.

#### 4.10 Road Speed Sensor

An input of road speed can be taken to allow traction control features. The input should be a pre-differential input, eg propshaft rpm, electronic speedo input, or driven wheel if using a locked diff. If you are using an LSD, a driven wheel input may be used but is not ideal. Please contact Omex for input suggestions.

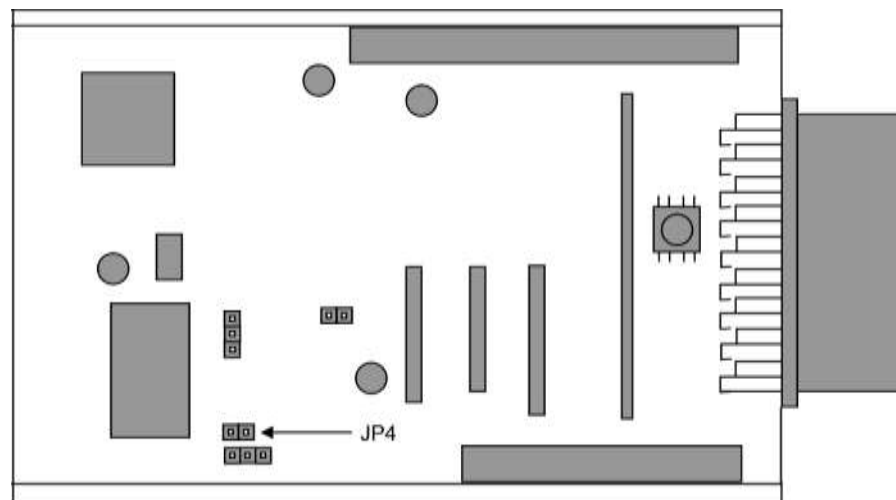


The ECU needs to convert the frequency of pulses to road speed. The option Road Speed M allows you to do this. Adjust this number until the parameter Road Speed shows the correct speed.



### Jumper

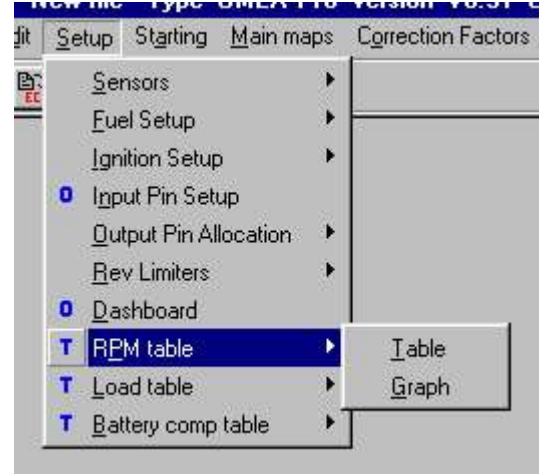
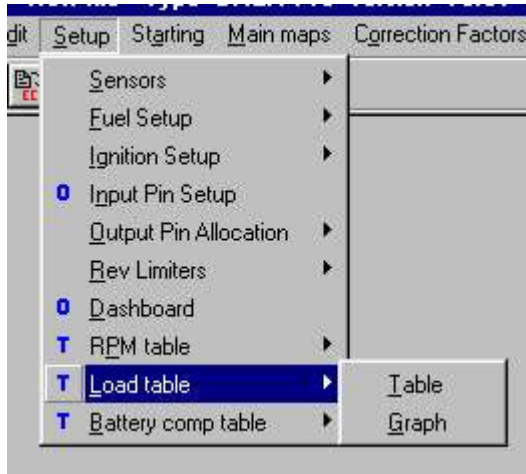
To allow for different types of sensor, physical jumpers need to be set. The following diagram shows an aerial view of the ECU board with the main wiring connector on the right-hand side.



Sensor Type	Jumper Position
Typical MVR	OFF
Hall Effect	ON

## 5 Map axes

The load and speed sites for the main maps can be set using the Load table and the RPM table.



## 6 Fuelling

The amount of fuel injected each cycle is dependent on the time the injector is open. This time period (or pulse width) is calculated by the ECU using factors for volumetric efficiency, air temperature, air pressure, cold start enrichment, injector flow rate and battery voltage etc.

Volumetric efficiency VE, the major factor, is determined by the throttle position or inlet manifold absolute pressure as measured with the TPS or MAP sensor, and engine speed using a three-dimensional look-up table. This 3D table is a simple grid with LOAD along one axis and engine speed along the other. It is what is programmed by the user, ie the map.

The LOAD axis has 14 sites. The engine speed axis is divided into 21 sites. These sites can be set by the user in the **RPM Table** and **Load Table** to give the desired resolutions at different areas of the map.

At each intersection of an engine speed site and a throttle position site there is a grid value. This is the volumetric efficiency value or V.E. and is directly proportional to the pulse width and therefore the amount of fuel injected.

These values are determined by running the engine on a dynamometer at each obtainable point and adjusting the VE values to obtain optimum performance. (ie mapping the engine).

If the engine is running at an exact engine speed site and an exact throttle position site then the VE value at the intersection of these two sites will determine the amount of fuel injected. If running at a condition where it is not exactly on a mapped site, the ECU interpolates between the nearest sites.

The fuel map can be viewed in 3 ways (see MAP3000 manual for how to change view types) – pulsewidth (msec), duty cycle (percentage opening), or raw. Raw numbers are the numbers used whilst mapping. Pulsewidth and duty cycle are calculated by the PC and are used for reference.

$$\text{Base fuel pulsewidth} = \text{raw (map) value} \times \text{Microsec/bit}$$

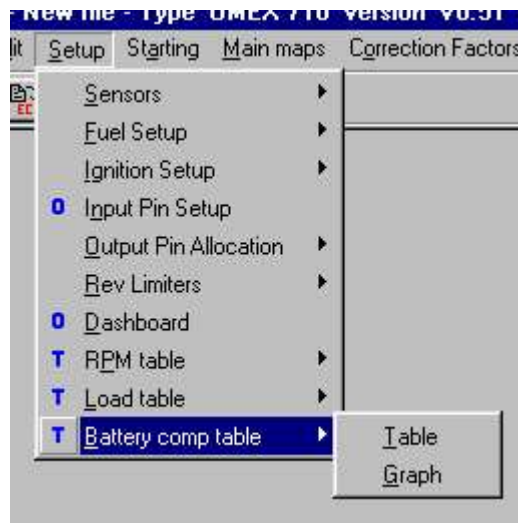
As a starting point it is quite acceptable to set **Microsec/bit** to 50. This will give a very good starting point for most engine setups. Once a sample full throttle point around maximum torque has been mapped, the **Microsec/bit** can be adjusted to give a maximum fuel map setting of 200 or so.

### Injectors

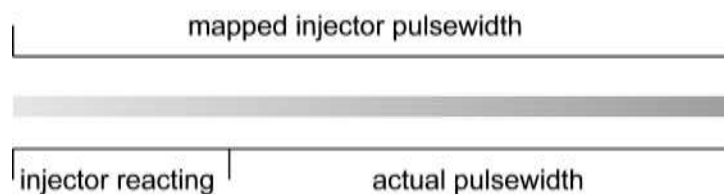
There are two electrical types of injector, high impedance, and low impedance. High impedance is approximately 12 ohms, and low impedance is approximately 3 ohms. The OMEM710 ECU is designed to use high impedance injectors, but can be used with low impedance if ballast resistors are used. The ballast resistors are shown in the wiring diagram.

Injectors are available in a range of flowrates. Please contact Omex for advice when selecting injectors.

## 6.1 Battery Voltage Compensation



An injection period is made up physically of 2 time periods. The end period is when the injector is open and flowing fuel, and the first period is when the injector is opening its valve and there is no flow of fuel. At low injector durations, this period where the injector is reacting but not flowing fuel can be significant.



This time period of no flow varies in length with battery voltage and with fuel pressure. This also varies between injector models. Were an engine to run at a constant voltage, then there would be no problems as the injector reaction time would be a constant length. However, the injectors do see a varying voltage so the ECU needs to allow for this varying period of no fuel flow, and as all types of injector react differently, it needs to be told this information by the user. The information is held in the ECU in the **Battery Comp table**.

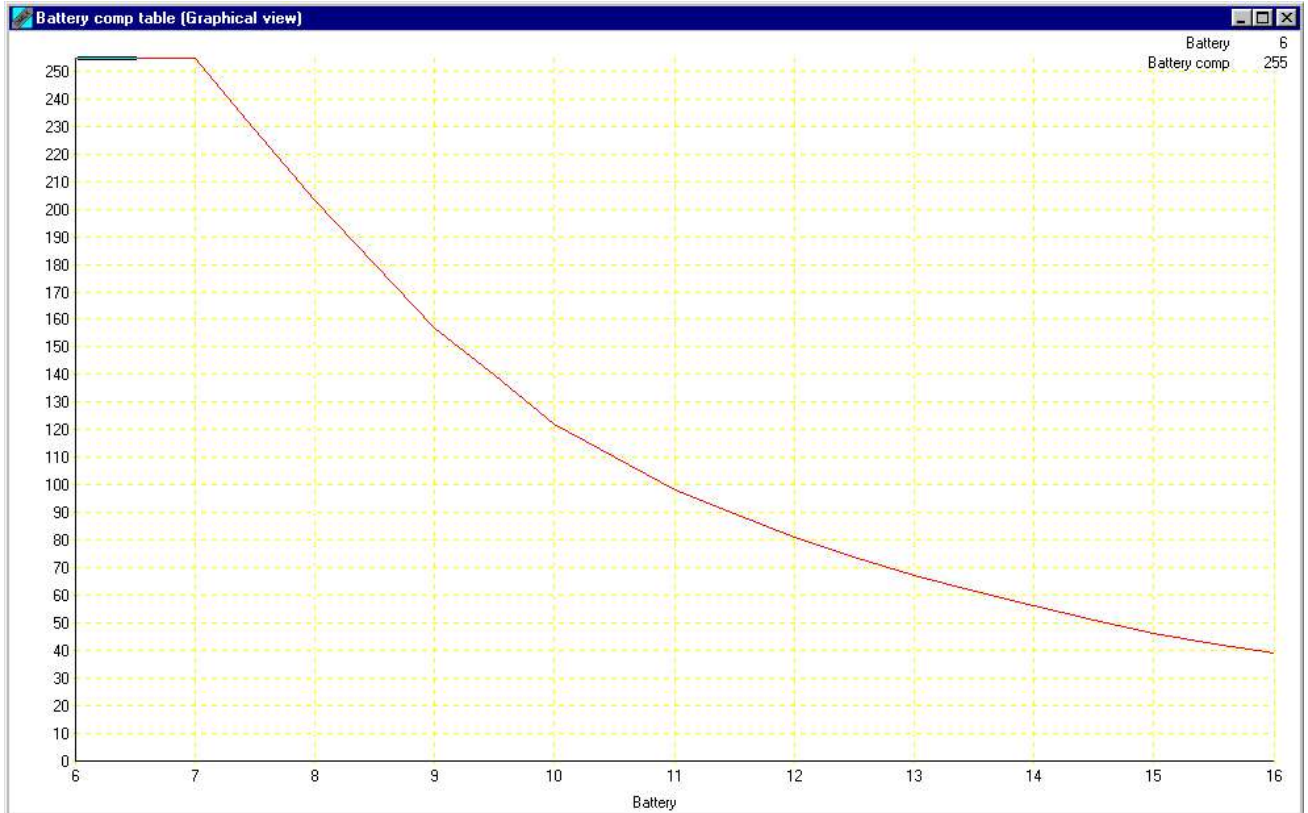
The battery voltage compensation data can usually be supplied by the injector manufacturers. For example, the Weber IW 058 injector data is for 3bar fuel pressure,

Battery Volts	Offset time mSec
8.0	2.03
10.0	1.22
12.0	0.81
14.0	0.56
16.0	0.39

The Omex ECU can not take the data in the form of offset time in msec, it instead requires the table to hold the data as a number between 0 and 255 which is then scaled. If using offsets from injector manufacturers simply multiply the offset time, usually stated in mSec, by 100.

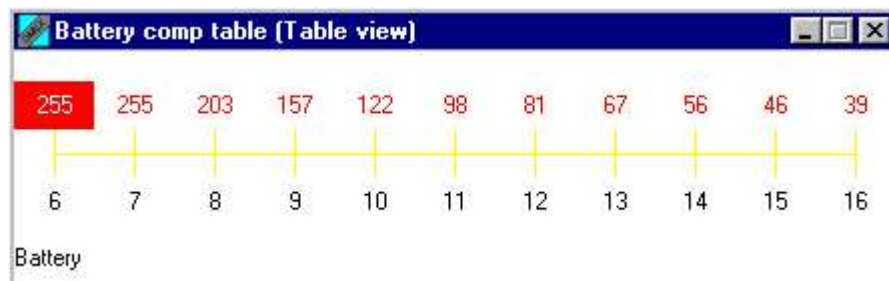
Battery Volts	Battery Comp
8.0	203
10.0	122
12.0	81
14.0	56
16.0	39

The missing values for odd voltages are best blended using the graphical display of **View | Battery Comp Table | graph**

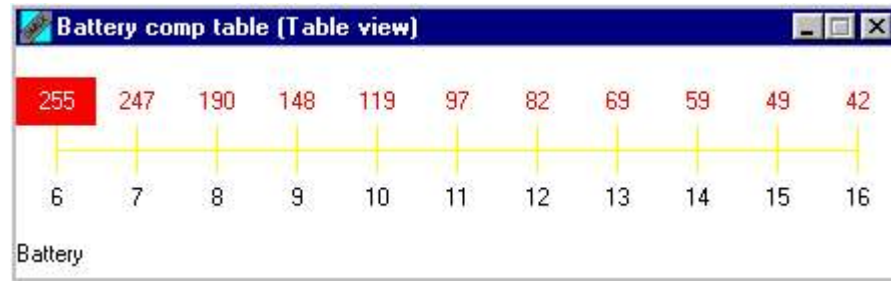


The values for known injectors at 3bar fuel pressure are as follows

IW058 (OMEM3004)



IWP043 (OMEM3002) and IWP069 (OMEM3003)

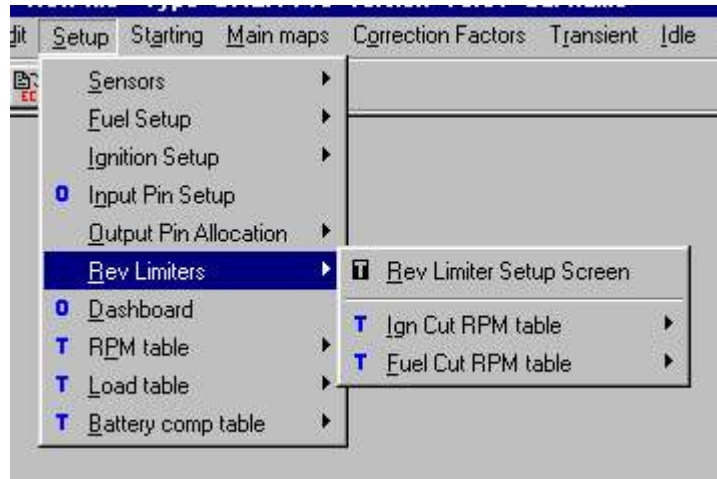


If this information is unavailable for your injector, then you will need to find these values yourself.

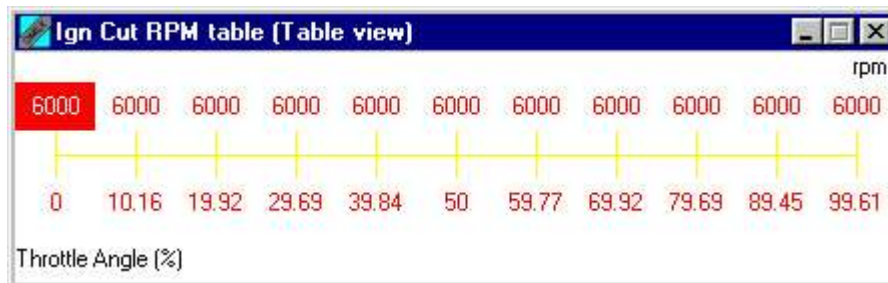
- Connect a power supply to run the injectors and ECU at variable voltages
- Fully map the engine at a normal running voltage
- Find a steady point somewhere off idle eg 10% load 3000 rpm, and note the lambda reading at this point
- Change the voltage of the power supply to one of the voltages on the **Battery Comp table**
- The lambda reading may change. If so, change this voltage's value in the **Battery Comp table** to return the lambda to the original reading
- Repeat this for all of the possible voltages

If a power supply is unavailable, then an attempt can be made to bring down the voltage in road cars by turning on lights, a/c etc.

## 7 Rev Limits

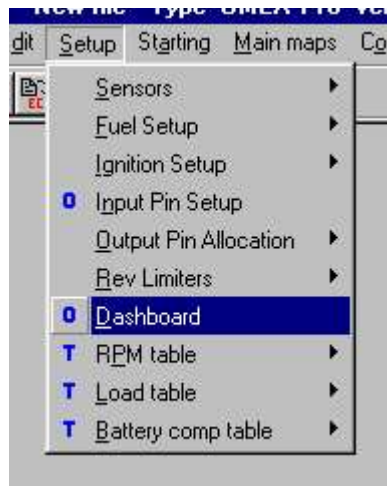


The tables Ign Rev Limit and Fuel Rev Limit allow differing rev limits based upon throttle position for when using anti-lag. If you are not using anti-lag, set all of the throttle positions in the table to the same engine speed. An example of a 6000rpm limit is as follows.



At this engine speed, the soft cut will be invoked. If the engine speed is exceeded by 50 rpm, then the hard cut is invoked. For information about soft and hard cuts see the advanced rev limits section.

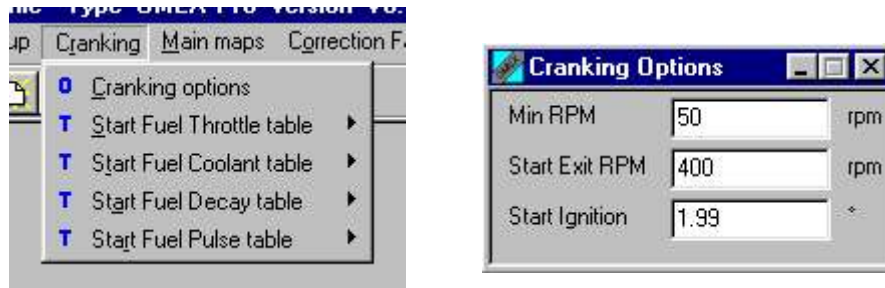
## 8 Dashboard



The frequency of pulses for the tacho is set by the option **Tacho Teeth**. Adjust this number until the tacho reads the correct engine speed.

## 9 Engine Start Condition

During cranking, the fuel and ignition are not controlled by the main fuel and ignition maps, but instead by tables and options.



The cranking condition is defined by the engine speed options **Min RPM** and **Start Exit RPM**. **Min RPM** is the engine speed at which the engine is considered to start cranking (typically 50 rpm), and **Start Exit RPM** is the engine speed above which the engine is considered to be under normal running ie no longer cranking.

### 9.1 Ignition

Whilst cranking, the ignition timing is determined by the **Start Ignition** option. This is set in degrees and would normally be a low value eg 2 degrees.

### 9.2 Fuel

**Start Fuel Pulse Table-** This is a single shot of fuel that may be injected into the engine at the start of cranking. The value in the table-selected dependent on temperature is multiplied by **Microsec/bit** to give the fuel pulse in micro-seconds

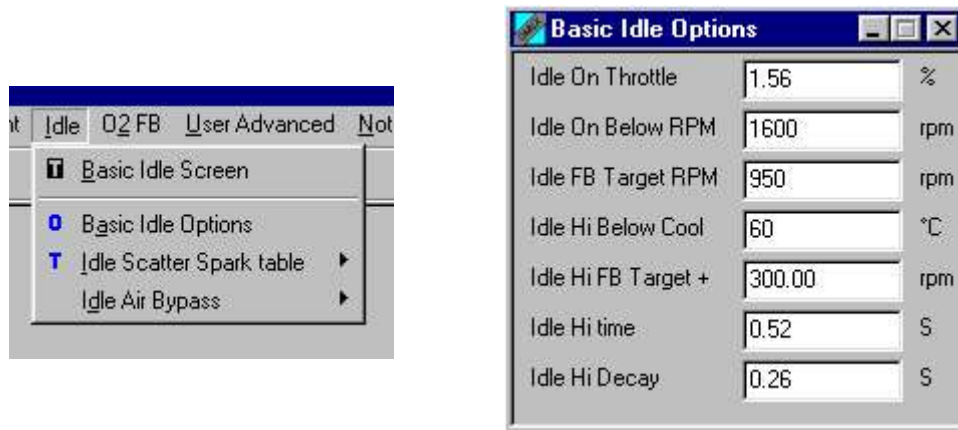
**Start Fuel Throttle Table** – This is the amount of fuel injected in cranking, dependent on throttle position, while the engine is starting. This value is VE (same as main map) so is multiplied by **Microsec/bit** to give the fuel pulsewidth.

**Start Fuel Coolant Table** – Extra fuel added to the Crank Fuel due to temperature.

**Start Fuel Decay Table** – This determines how quickly the additional start fuel decays over time. This is a linear decay in seconds after cranking commences.

## 10 Idle Strategies

The 710 series ECU can control idle using spark scattering, push/pull motors and stepper motors.



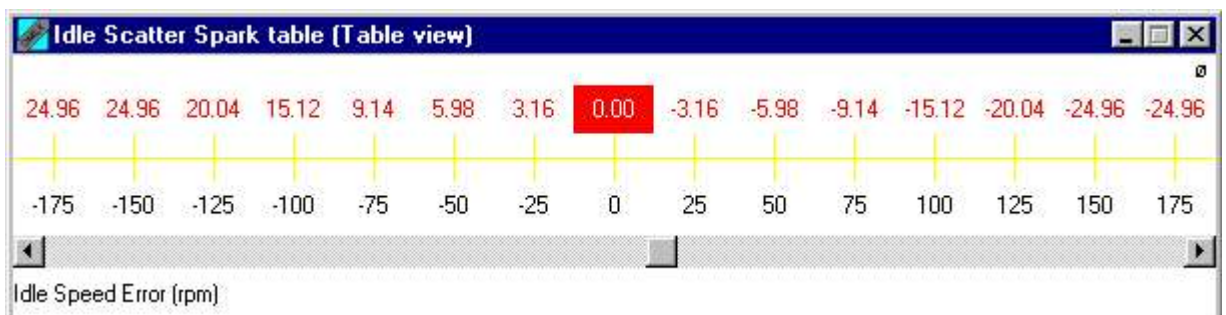
The idle condition is entered by the options **Idle on Below RPM**, and **Idle Below Throttle**. The engine condition must be below both of these two values to enter idle.

The target idle speed that the ECU attempts to maintain is set by **Idle FB Target**.

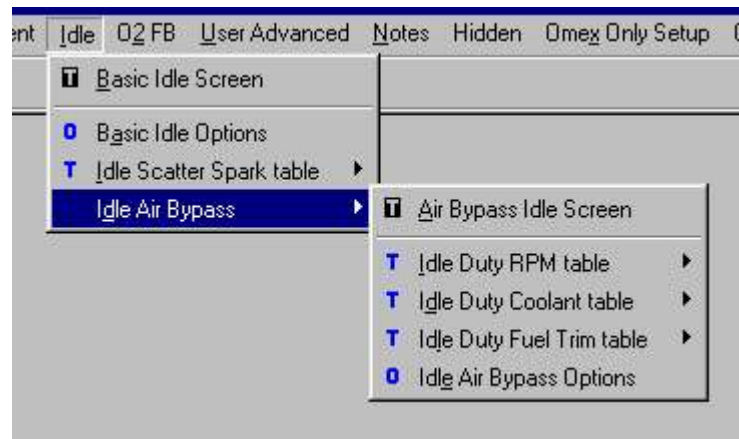
A high idle will be required in some conditions. The ECU can set a high idle speed based on coolant temperature (**Idle Hi Below Cool**), or as engine speed drops towards idle to prevent engine stalling (**Idle Hi Time**). The target idle increase above the normal idle speed for high idle is **Idle Hi FB Target+**. When returning to the normal target idle speed the target speed is reduced over a period of time set by **Idle Hi Decay**.

### 10.1 Scatter Spark Idle

The **Idle Spark Table** shows the change in ignition timing based upon rpm away from the target engine speed. When the idle is high, negative values are required to decrease the idle rpm, and when the idle is low, positive values are required to increase the idle rpm. As the engine moves further away from the target idle, the numbers should increase.



## 10.2 Air Bypass Idle

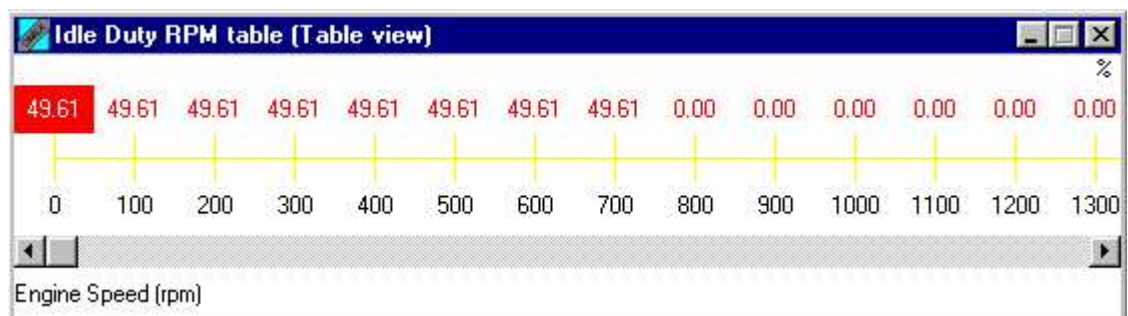


There are three types of air bypass motor. 2 wire push/pull, 3 wire push/pull, and stepper motor. Please contact Omex if you wish to use a stepper motor.

**Idle Duty Max** is the duty cycle above which the idle motor does not flow extra air.  
**Idle Duty Min** is the duty cycle below which the idle motor does not flow any air.

The **Idle Duty Coolant table** gives the % opening of the idle motor required at each temperature to achieve the base target idle.

The **Idle Duty RPM table** is a modifier based on engine speed for if the engine speed moves below the target idle ie anti-stall. The target idle speed should have a modifier of **0**. Engine speeds well below target should have a large positive number to open the idle motor to stop the engine stalling. The example below is typical for a 1000rpm idle.



The idle is then fine-tuned and maintained by the feedback loop. **Idle FB- max** and **Idle FB+ max** are the feedback limits for the idle motor. The update rate of this feedback loop is set by **Idle FB Rate**. This would typically be **40ms** with a stepper motor or **200ms** with a PWM device.

The **Idle Fuel table** is required for engines that are using air bypass with throttle position as the main load sensor. On TPS load based engines, the ECU does not measure the extra air flow due to the opening of the idle motor, so does not compensate with extra fuel in the main fuel map to maintain the target lambda (air/fuel ratio). An oxygen sensor cannot make adjustments to the fuelling fast enough to cope with these changes. This table allows a fuel trim based on idle motor duty to maintain a constant lambda value. This is not required for MAP or MAF based systems.

## 10.3 High Idle

When the engine enters Hi idle conditions, the option **Hi Idle Duty** is the increase in duty cycle required to reach the **Hi Idle Target RPM**

## 10.4 Air Con Idle

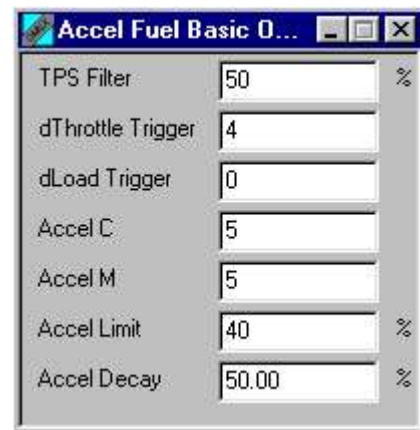
When an air conditioning pump switches ON, the load on the engine increases and so the idle speed will momentarily decrease. The idle feedback loop will allow the idle speed to recover, but the **Idle A/C Duty+** option is an instant increase in idle motor duty when the A/C input is ON so that the momentary dip in engine speed is reduced.

## 11 Transient Conditions

The fuel map contains the fuel for steady state running. Fuel transients such as acceleration and deceleration of the engine especially at gear changes may require different fuelling. To prevent excessively lean or rich stumbles and emission control problems the ECU has three functions; throttle triggered acceleration fuel enrichment, MAP triggered acceleration fuel enrichment, and deceleration fuel cut off.

### 11.1 Acceleration Fuel

#### Basic



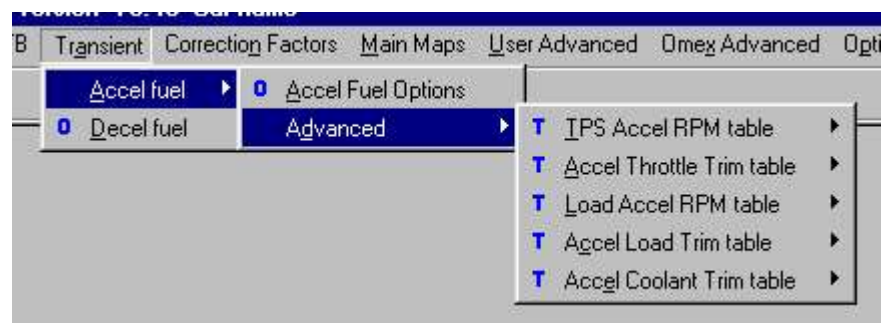
Acceleration fuelling can be triggered by a rate of change of value of throttle position or of MAP value or both. This is described by the options **dThrottle Trigger** and **dLoad Trigger**.

Once triggered, the ECU will output an amount of fuel (**Accel c**) and then an extra amount dependent on the accel rate above the trigger value (**Accel m**).

The amount of acceleration fuel is capped to a maximum regardless of the calculated value by the option **Accel Limit**.

The acceleration fuel is decayed as described by **Accel Decay**. If zero, the accel fuel would decay to 0 after 1 injection event.

#### Advanced



The engine usually requires less acceleration fuel at high rpm, so the **TPS Accel RPM table** and **Load Accel RPM table** describe the percentage of the calculated fuel supplied at differing engine speeds.

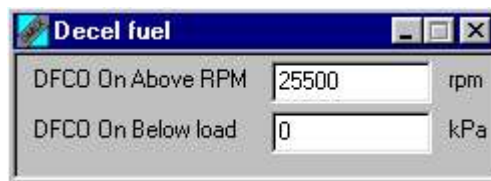
The **Accel Throttle Trim table** and **Accel Load Trim table** allow the accel fuel to be modified for the throttle position or manifold pressure at which the accel fuel was tripped, therefore giving varying accel fuel at different engine loads.

When the engine is in warm-up, it may require extra acceleration fuelling. This is described in the **Accel Coolant Trim table** as a percentage extra acceleration fuel.

## 11.2 Deceleration Fuel Cut Off

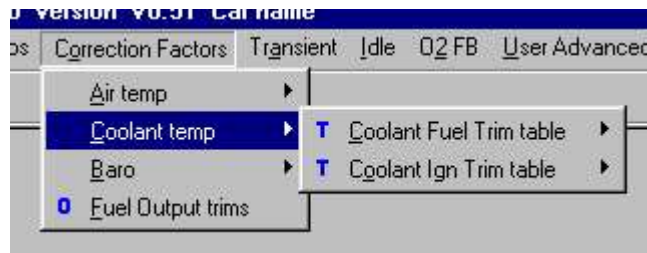


When this function is active ie above the engine RPM and below the engine load, the injection pulsewidth is reduced to a minimum. This feature is not normally used on high performance and race cars. To disable this feature set as follows.



## 12 Correction Factors

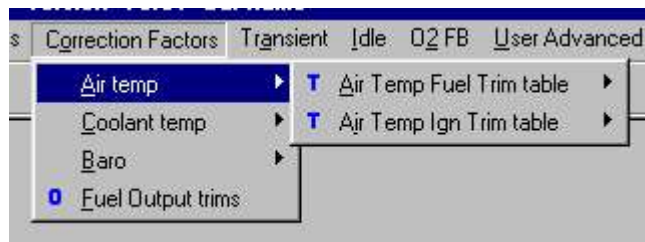
### 12.1 Coolant Temperature



When the engine is cold, it requires an extra amount of fuel. This extra fuel is added as a percentage set in the **Coolant Fuel Trim table** of percentage increase against engine coolant temperature.

Ignition can be trimmed based upon coolant temperature. This is only used for extremes of temperature. This is described by the **Coolant Ignition Trim table**.

### 12.2 Air Temperature



If you wish to change the fuelling with air inlet temperature, then the **Air Temp Fuel Trim table** allows the user to make a percentage change in fuel based on AIT.

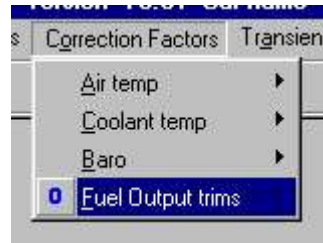
Ignition can be trimmed based upon air inlet temperature. This is only used for extremes of temperature. This is described by the **Air Temp Ign Trim table**.

### 12.3 Barometric Pressure



The fuel and ignition can be trimmed to allow for changes in barometric pressure as sensed by a 1bar pressure sensor. The ignition trim is defined in the **Baro Ign Trim table**. The fuel trim values are a known mathematical equation so are inbuilt and are non-adjustable.

## 12.4 Individual Fuel Output Trims

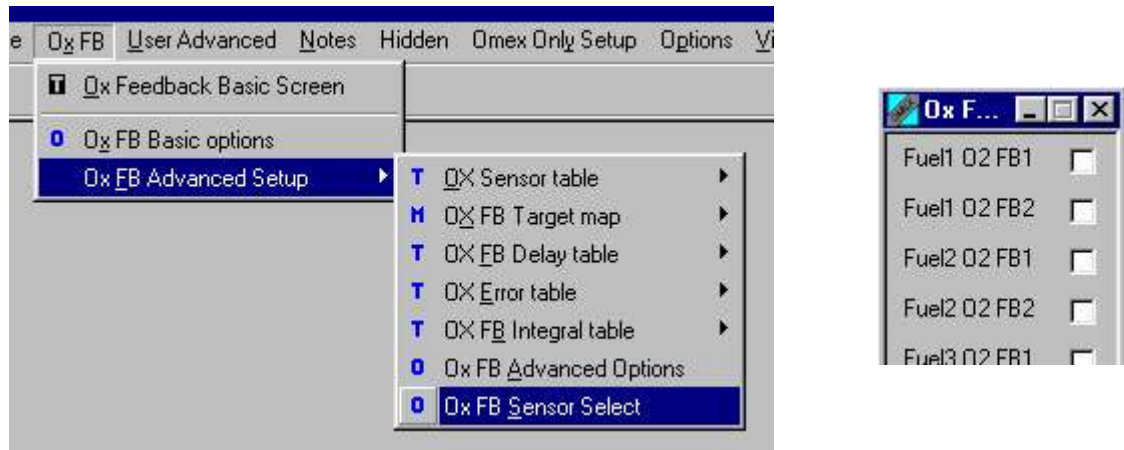


Each fuel output can have a percentage trim. This trim happens all of the time under all engine conditions. This would normally be set to all outputs 0%.

## 13 Oxygen Feedback

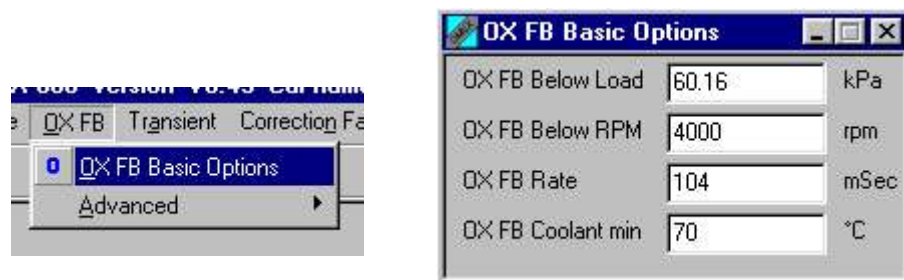
The ECU can take inputs from either narrowband or wideband oxygen sensors. This information is then used to make constant trims to the fuelling.

For banked engine with two exhausts, the ECU can take inputs of two lambda sensors. To assign the fuel outputs to the oxygen sensors, use the Ox FB Sensor Select option group.



There is a large amount of theory, and many different options, involved in setting up the complicated oxygen feedback as this ECU is capable of meeting very strict emissions requirements. Fortunately, these complicated equations have already been tackled, and nearly all engines require the same settings for oxygen feedback, so it can be set relatively easily.

### 13.1 Narrowband Basic

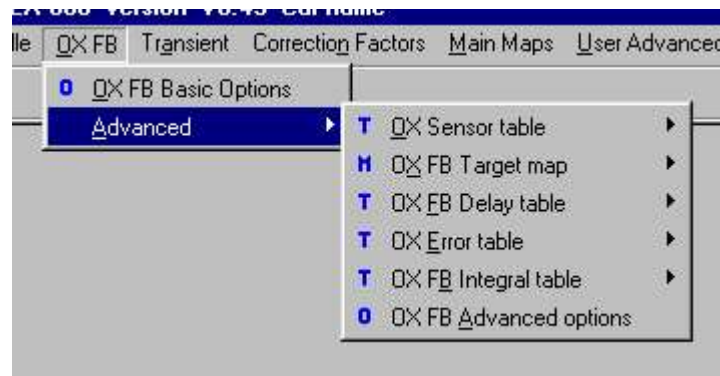


A narrowband exhaust gas oxygen sensor may be employed to trim the fuelling to maintain a stoichiometric ( $\lambda=1$ ) air/fuel mixture to enable an exhaust catalyst to function efficiently and reliably. Any 4 wire (ie heated) narrow band lambda sensor can be used.

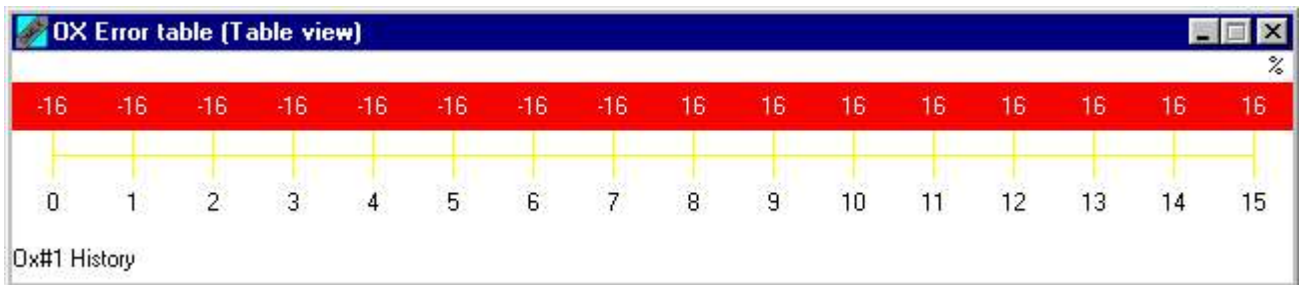
Start-up maps from Omex will be programmed with oxygen feedback numbers for narrowband sensor feedback so in most cases all that is required is to turn on the function.

- **Ox FB Below Load** and **Ox FB Below RPM** are the engine load and engine RPM values below which the oxygen feedback is active. Typically these cover the emissions test and gentle driving conditions. eg 4000rpm and 40% load
- **Ox FB Coolant min** is the minimum engine coolant temperature at which the engine is able to run at  $\lambda=1$  ie the temperature at which it no longer requires warm-up fuel enrichment. Typically 60-70C.
- **Ox FB Rate** is the update rate of the sensor, typically 100. Setting this to 0 disables the oxygen feedback.

## Advanced

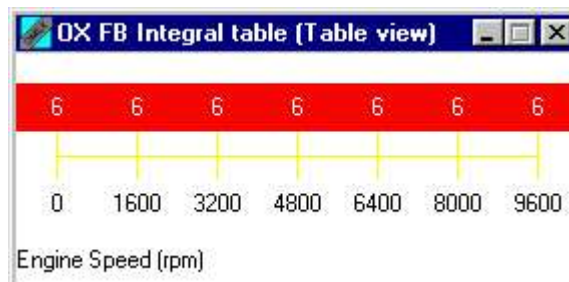


The following is a list of the maps, tables and options, typical values, and their use in oxygen feedback. It is strongly recommended that these values are not changed without consulting Omex.

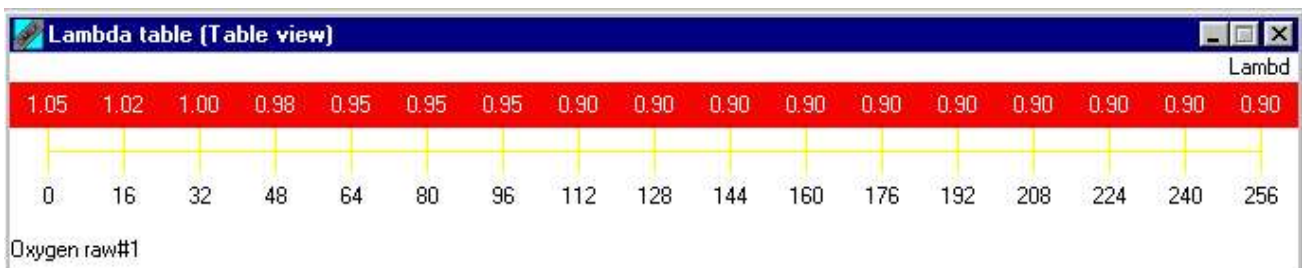


**Oxygen Error table** – If the feedback rate is not fast enough (the engine swings from rich to lean for long periods of time), then these numbers may be increased

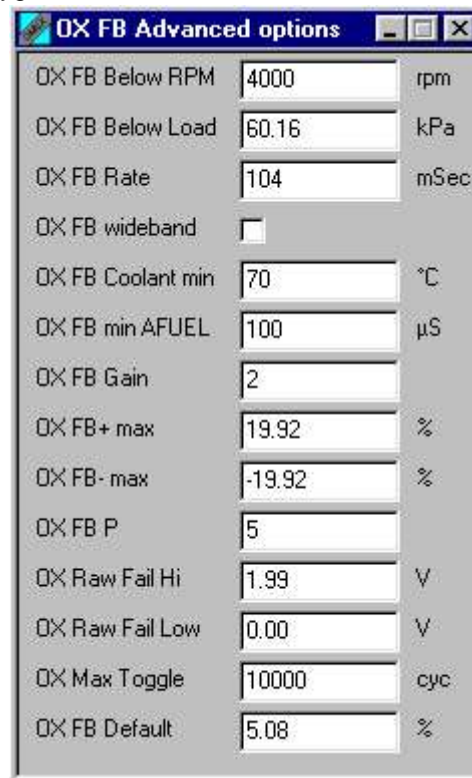
**OX FB Integral Table | Table** input the following values.



**Lambda Table | Table** input the following values. This shows that at a raw value of below 32, the engine is lean, and at a raw value of above 48 the engine is rich.



The **Lambda Target Map** shows the target lambda value for all engine speed and load conditions. In the case of narrowband oxygen feedback the whole table should be set to a value of 1.



**OX FB +max** and **OX FB –max** are the percentage fuel trim limits for the oxygen feedback.

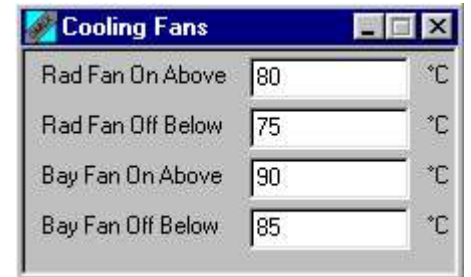
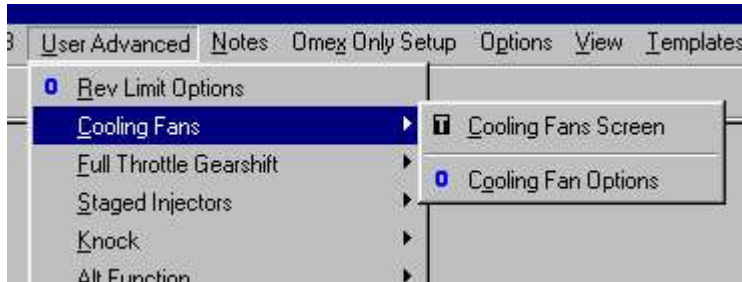
The oxygen sensor takes a few seconds to warm up after startup as can be seen by its gradual increase from 1 on the **oxygen raw** parameter. Before the sensor is warm we wish to ignore its value as it will trigger fuelling changes that are not needed. The delay after engine start before starting oxygen feedback is set in the **OX FB Delay Table**.

## 13.2 Wideband

Contact Omex.

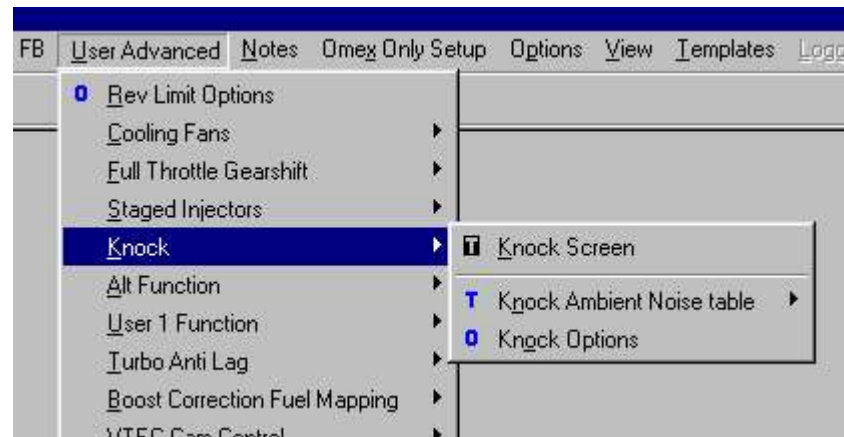
## 14 Cooling Fans

The ECU has two software outputs switchable on coolant temperature values. These would normally be used for cooling fans. The two outputs may be set to two different fans or set at different temperatures for twin speed fans.



- Rad Fan On** temperature at which the rad fan output is on
- Rad Fan Off** temperature at which the rad fan output is off. Set a few degrees lower than Rad Fan On to allow hysteresis
- Bay Fan On** bay fan on at this temperature
- Bay Fan off** bay fan off at this temperature. Set to a few degrees below Bay Fan On to allow hysteresis

## 15 Knock Control



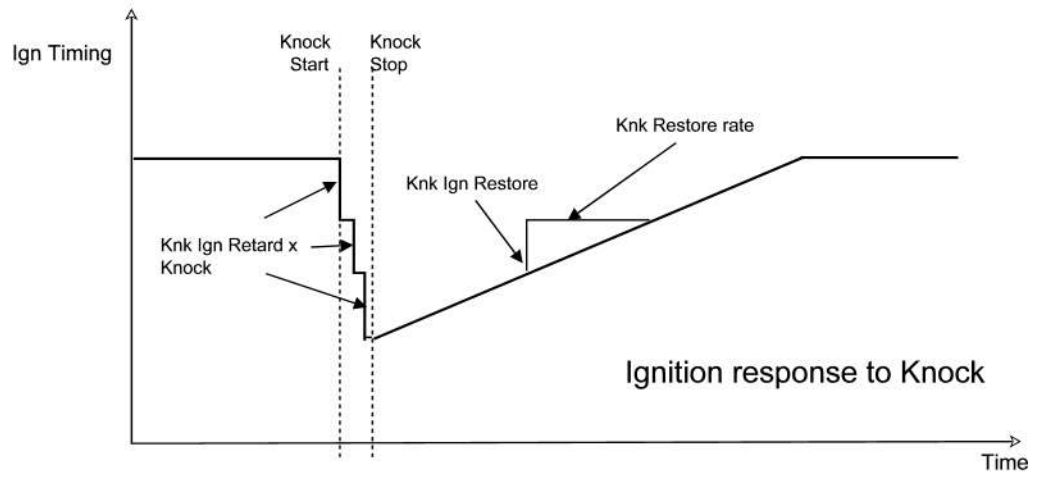
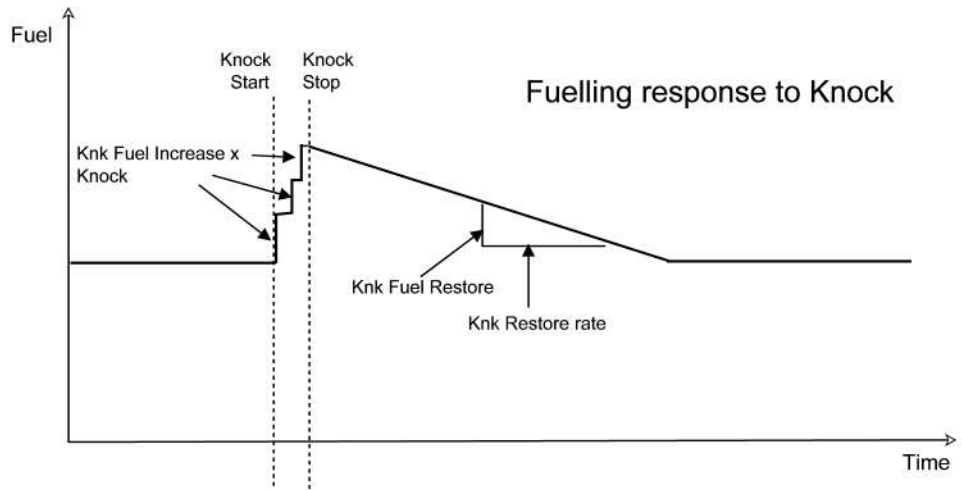
Engines make mechanical noise that varies dependent on engine speed. The **Knock Ambient Noise Table** describes this normal background engine noise when running out of knock. The parameter **KNKRAW** shows the current noise measured by the knock sensor. Logging the parameter **KNKRAW** on a full load engine run whilst using a safe ignition map allows you to draw the table of normal noise.

When **KNKRAW** exceeds the **Knock Ambient Noise table** values, the engine is assumed to be in knock. The level of noise above the normal noise is shown by the parameter **Knock**.

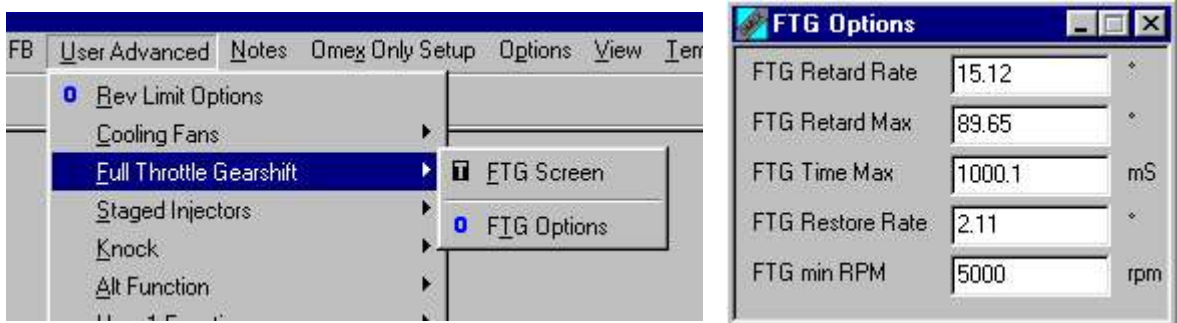
When knock is discovered, the ECU needs to react by retarding the ignition to stop knock, and increase the fuelling to cool the cylinder.

The **Knock** value causes an ignition retard (**Knk Ign Retard**) and an increase in fuel (**Knk Fuel Increase**) proportional to the Knock level. The ECU will make these changes to the timing and fuelling every 4ms until knock has stopped. The extra fuel and the ignition retard are capped to a maximum regardless of the calculated values by **Knk Fuel max** and **Knk Ign Retard max**.

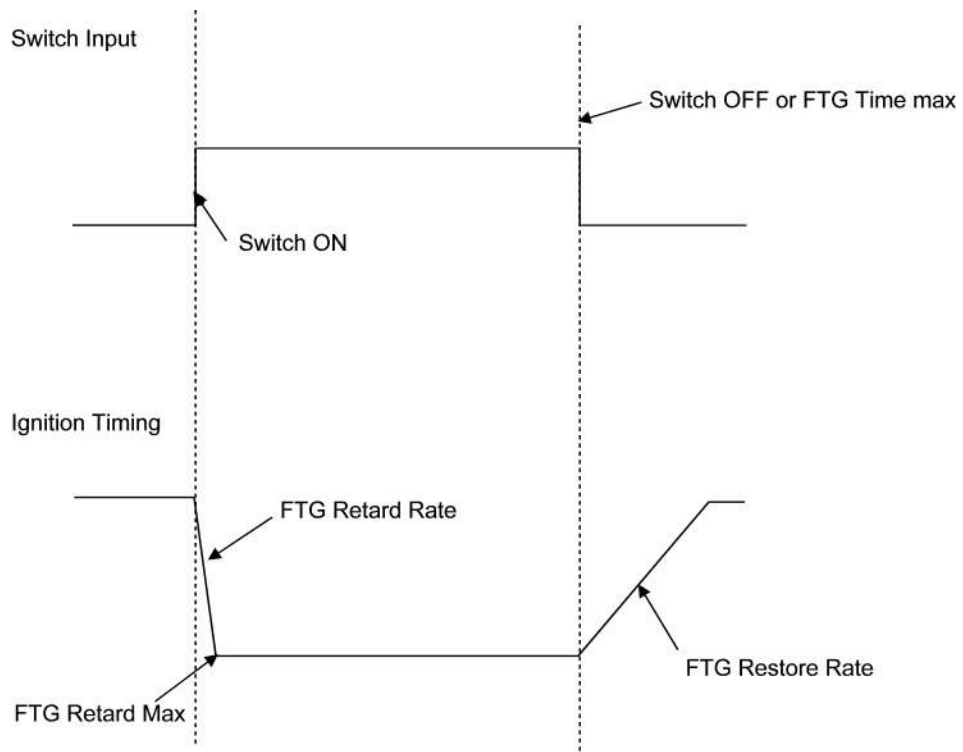
After knock has stopped, the fuelling and ignition values need to be returned to normal. The rate is set by **Knk Restore Rate** (engine revolutions) and then **Knk Fuel Restore** (% fuel per rate) and **Knk Ign Restore** (degrees ignition timing per rate).



## 16 Full Throttle Gearshift



The full throttle gearshift is a switched ignition retard function. When the input for this function is satisfied (normally by a physical input switch on the clutch pedal or gearstick), the ECU retards the ignition at a rate, **FTG Retard Rate**, up to a maximum retard, **FTG Retard Max** (The maximum retard is relative to the current map value, not absolute). When the input switch changes to **OFF**, the ignition retard will be returned at a rate, **FTG Restore Rate**, until the normal ignition timing is reached. If the input does not go to **OFF**, the timing will be returned after a time set by **FTG Time max**. The retard rate is degrees per 4ms and would typically be very fast (10-15) then the advance slower (2-3). The option **FTG min RPM** is the minimum engine RPM at which a full throttle gearshift retard can be performed. This prevents the engine RPM from dipping when depressing the clutch whilst stationary.



## 17 Staged Injectors



The Injection outputs 1 - 12 may be assigned to Primary (Fuel\_Primary) or Secondary (Fuel\_Secondary). This feature allows two banks of injectors to be fitted to each inlet.

### 17.1 Twin Injectors

If using two injectors per cylinder to allow greater fuel flow, typically on high boost turbo engines, the ECU can automatically assign pulsewidth greater than the user defined **Pri Inj Duty Max** to the second set of injectors.

<b>Pri Inj Duty Max</b>	when using double injectors, this is the maximum duty cycle the primary injectors will reach before extra pulsewidth is sent to secondary injectors
<b>Sec Inj Min Pulse</b>	hysteresis for the automatic staged injectors as injectors will not react to very small pulse widths. This is the minimum pulse width that will be sent to the secondary injectors.
<b>Primary Size %</b>	If using two different sized injectors, this option must be used to allow for this. $\text{Primary Size \%} = (\text{Primary flowrate} / \text{Secondary flowrate}) \times 100$ .

### 17.2 Staged Injectors

If using two sets of injectors arranged upper and lower banks where the upper bank is used for increased power at high rpm, the **Fuel Difference table** allows you to assign different percentage of the fuel pulsewidth to each bank.

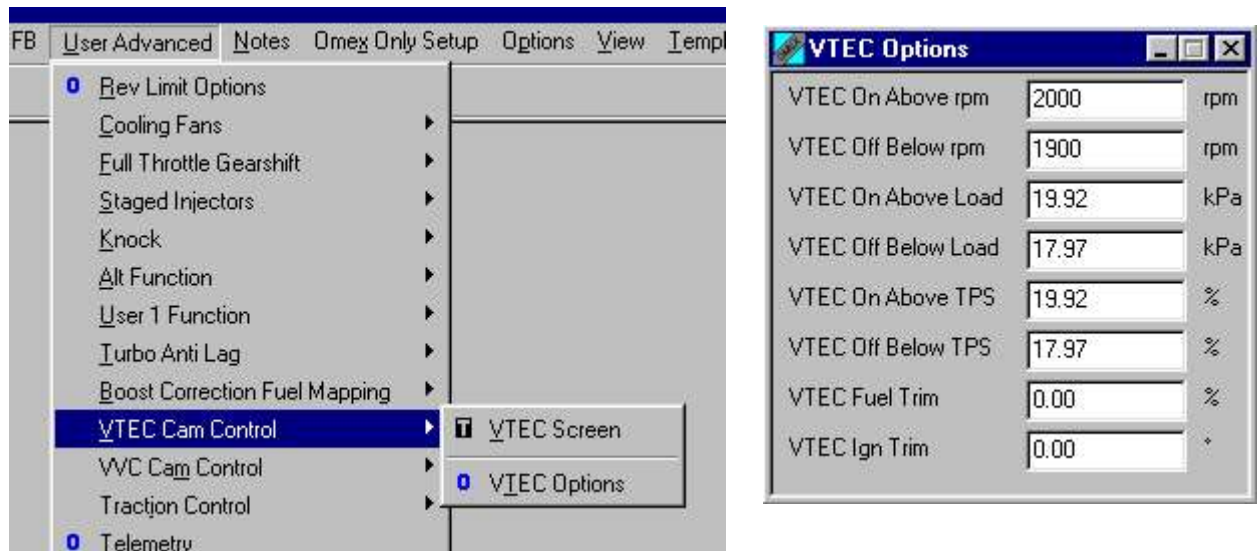
The **Fuel Difference table** describes the percentage of the mapped pulse width at any given load and speed to be sent to the secondary injectors. The remaining pulsewidth will be sent to the primary injectors. eg if the map reads 20, then 20% of the pulsewidth will go to the secondary injectors, and 80% to the primary.

This table is only used when the **Fuel Diff Input** is satisfied. This can be always satisfied by setting an input of **Switch Always ON**. (Setup | Input Pin Setup)



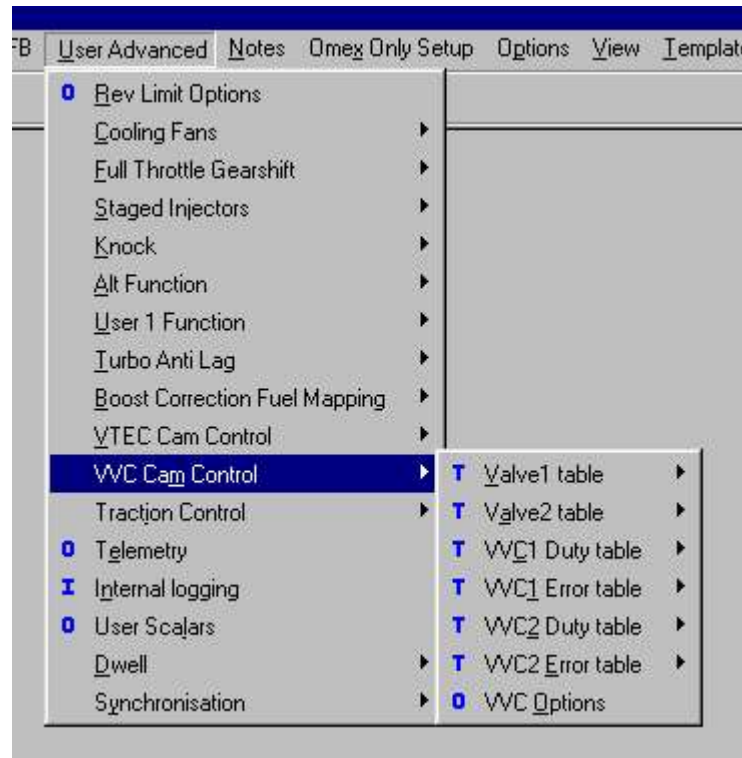
The values set in the twin injector options still apply when using the **Fuel Diff table**.

## 18 VTEC Cam Control



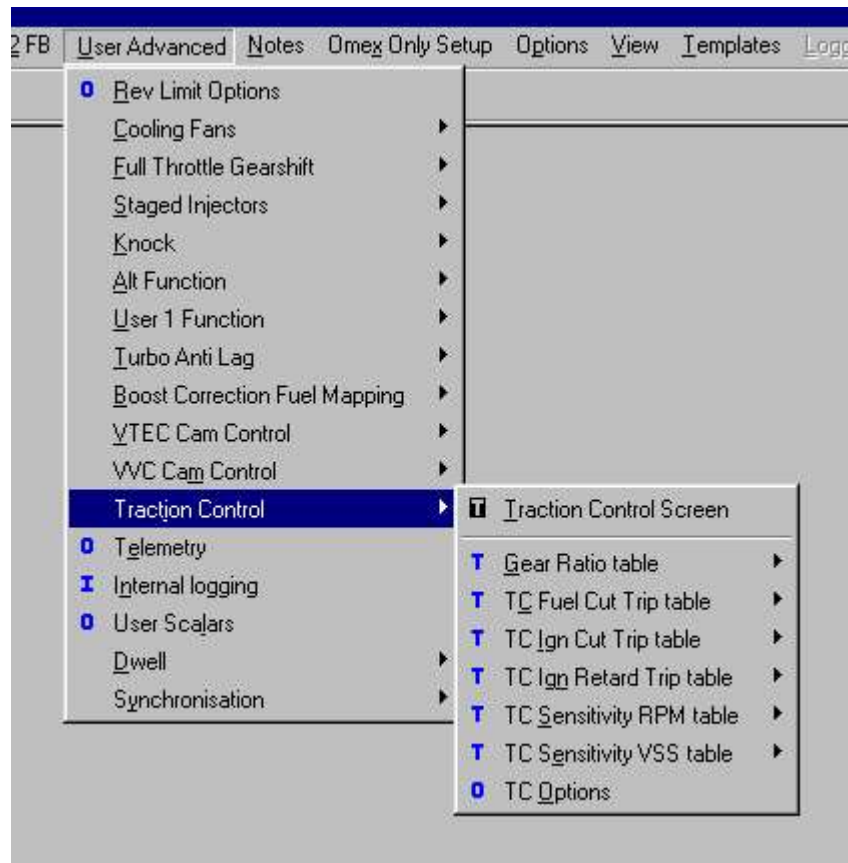
The simple on/off VTEC control is switchable on engine RPM, throttle position, and engine load with hysteresis provided by separate on and off points. In the VTEC condition there is also a fuel and ignition trim.

## 19 VVC Cam Control



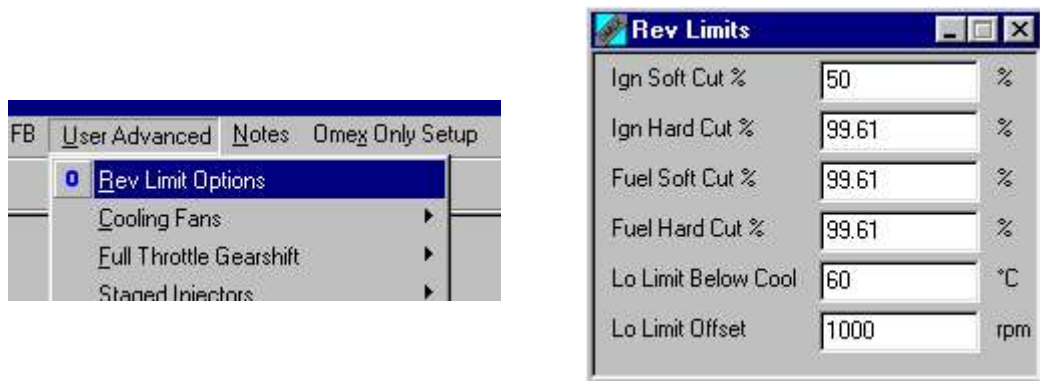
VVC (also known as many other names such as i-VTEC, VANOS etc) is constantly variable cam control. Normal VTEC will switch from one cam position to another whereas VVC allows any cam position within limits. The cam position varies with engine speed. Each manufacturer has a slightly different way of triggering this cam movement, so please contact Omex for advice on whether a particular engine has been run with the Omex VVC control.

## 20 Traction Control



Please contact Omex if you would like to use this feature.

## 21 Advanced Rev Limits



The tables **Ign Rev Limit table** and **Fuel Rev Limit table** allow differing rev limits based upon throttle position for when using anti-lag. If you are not using anti-lag, set all of the throttle positions in the table to the same engine speed. At this engine speed, the soft cut will be invoked. If the engine speed is exceeded by 50 rpm, then the hard cut percentage is added to the soft cut percentage. The ignition percentage is the percentage of sparks removed. The fuel cut is the percentage of fuel pulses removed. Fuel cut should be cut 100% even on its soft cut option.

A second rev limit can be imposed when the engine is below a specified temperature.

**Lo Limit Below Cool**      the temperature below which the cold rev limit is set  
**Lo Limit Offset**          the reduction in rev limit when rev limit coolant is satisfied

## 22 Turbo Boost Control

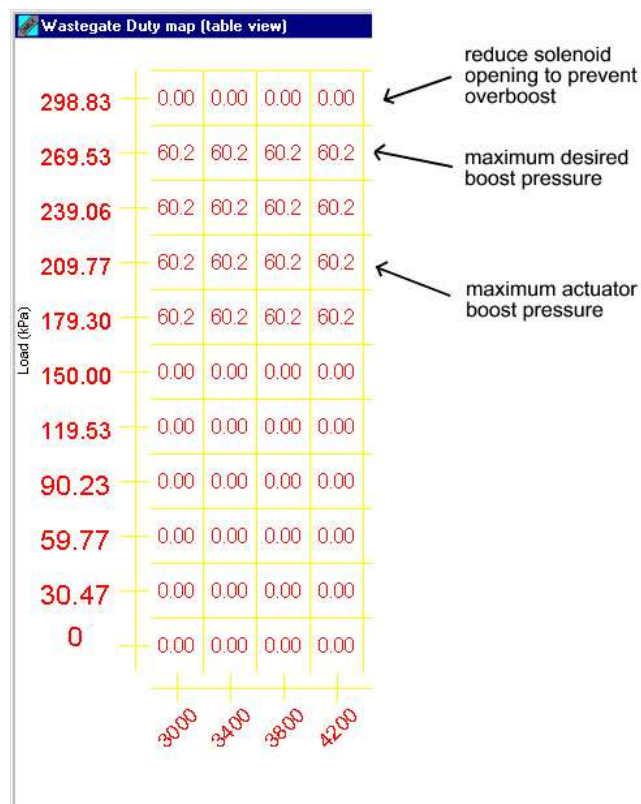


Boost pressure is regulated by the turbo wastegate which is opened at a boost pressure set by the actuator. To increase the boost pressure at which the wastegate is opened, the actuator needs to see a lower pressure than actually exists in the manifold. The ECU is able to control a solenoid to lower the pressure that the actuator sees, therefore increasing the boost pressure at which it opens the wastegate. The ECU can therefore never reduce the maximum boost to below that of the actuator setting, it can only be increased.

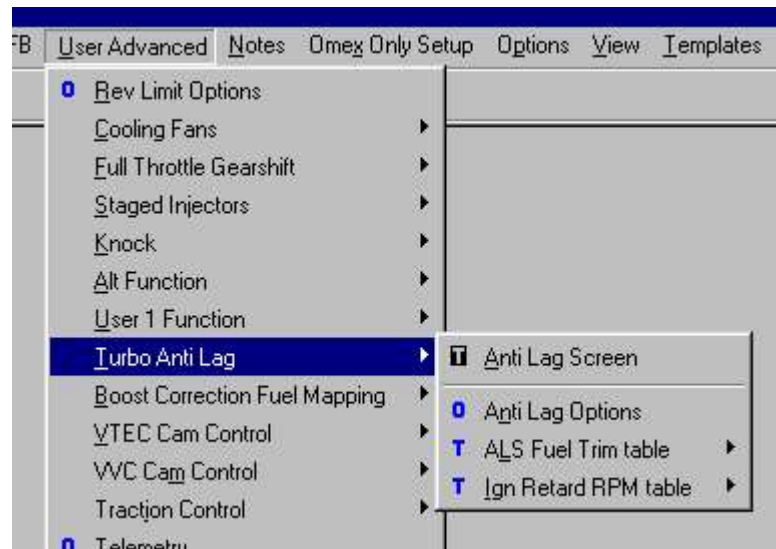
As the solenoid is a PWM device, the map describes the duty cycle of the solenoid against engine load (boost pressure) and engine speed. A value of zero would not activate the solenoid, and a value of 100 would have the solenoid open fully.

Normally, the engine would be first mapped without the boost control activated. The fuel and ignition values can then be guessed for the load sites not yet reached. The **Wastegate Duty map** is used to increase the boost to the required level, then these sites can be fully mapped.

The **Wastegate Duty map** is engine load (boost pressure) vs engine speed. At the engine speeds where extra boost pressure is desired, the solenoid may be opened just before the boost reaches the maximum permitted by the actuator to allow the engine to boost to the desired pressure. At boost pressures above the desired pressure, the solenoid should be closed again to prevent overboost.



## 23 Anti-lag



Anti-lag keeps the boost pressure high and the turbocharger spinning by keeping the gas flow high, but maintains drivability by controlling the torque. The gas flow can be achieved by jacking the throttle with a solenoid, air bypass valves, or if a low level of anti-lag is used, often by opening the idle motor. To control torque, the ECU retards the ignition and cuts fuel and sparks.

In reducing engine torque, anti-lag produces very high exhaust gas temperatures which can cause damage to the manifold and turbo. If using anti-lag, monitor exhaust gas temperature very closely when setting-up and consult your turbo manufacturer for guidance on maximum temperatures.

When the antilag input is satisfied, three tables are used to maintain engine speed based on throttle position – an ignition retard table, an ignition cut table, and a fuel cut table. Once the engine speed exceeds the speed in the table, the relevant soft cut option is invoked. If the speed is exceeded by 50rpm the hard cut option is added to increase the effect. The first torque reducer to use is the ignition retard, then the ignition cut, and finally if required, the fuel cut.

The **Ign Cut RPM table** and **Fuel Cut RPM table** found on the Anti-lag screen are copies of those found in **Setup | Rev Limiters**.

If using the idle motor to give anti-lag airflow, then the option **ALS Idle** is the percentage duty cycle added to the idle motor to open it when the **ALS input** is satisfied. This would often be 100%.

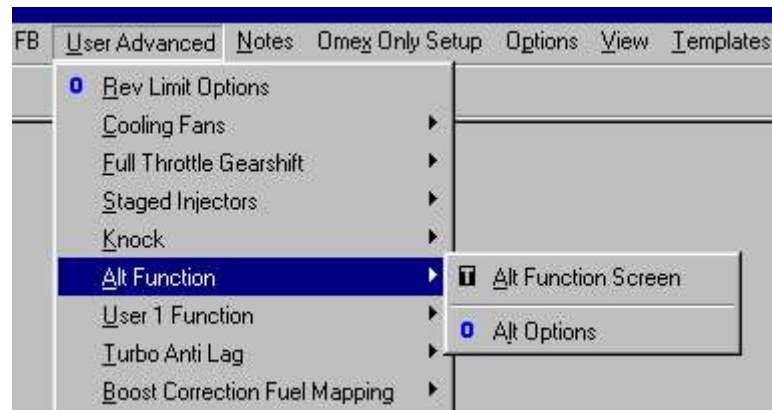
**ALS Air Max** is the air temperature above which ALS turns off and the ECU shuts its controlled valves.

**ALS Off Road Speed** – If the ECU has a road speed input, this option allows the anti-lag to be deactivated above a set road speed. This allows the anti-lag to be used as a launch control for engines that require boost at low RPM for launch.

**ALS Active Time** is the longest time the ECU will stay in anti-lag mode before turning off to prevent excessive exhaust gas temperatures if coasting downhill. **ALS Inhibit Time** is the minimum time after turning anti-lag off that it can turn on again.

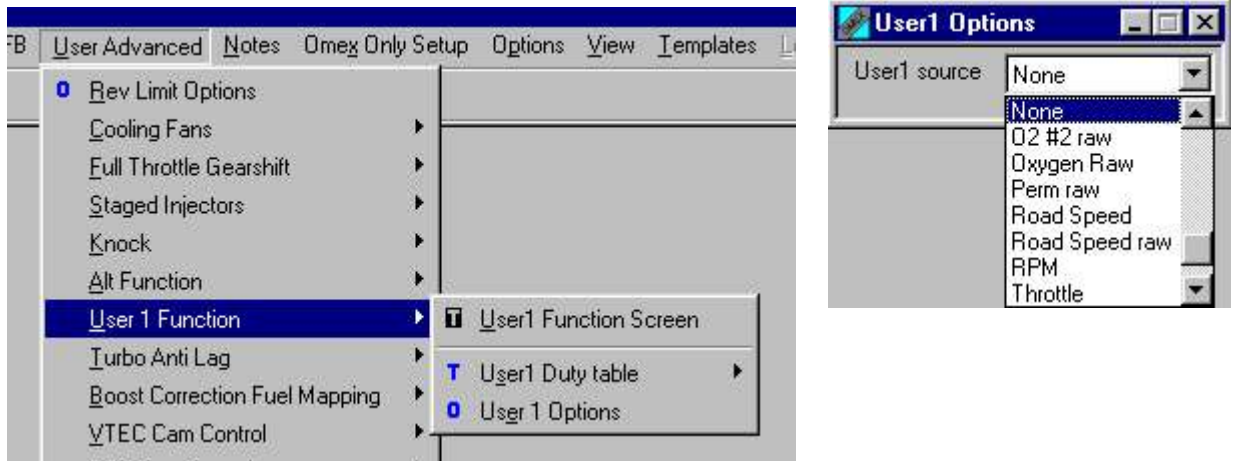
It is possible on some engines to create more boost in anti-lag mode by increasing the fuel. This is done using the **ALS Fuel Trim table**.

## 24 Alt Function



The Alt function is a possible fuel trim, ignition trim, and physical switch output based upon an entry condition set by the user. The entry condition can be a physical input switch, engine speed, engine load, throttle position, or a combination of these. The engine entry conditions have separate on and off points to give hysteresis. For the trims to be available simply on a switch, then set the rpm, TPS, and load on/off conditions to conditions the engine is always under. For the trims to be active under certain engine conditions without any switch input then set **Alt Function Input** to **Switch is Always ON**.

## 25 User1



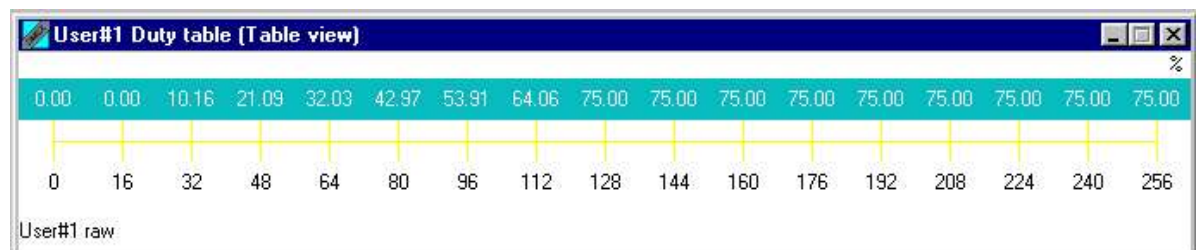
The ECU has a table **User1 table**. This table can use a raw source (scaled to 0-255) for the lower (input) axis of the table to drive a PWM output, the duty cycle of which is defined on the upper axis of the table.

The raw input is selected by option **User1 source**. Useful selectable sources are;

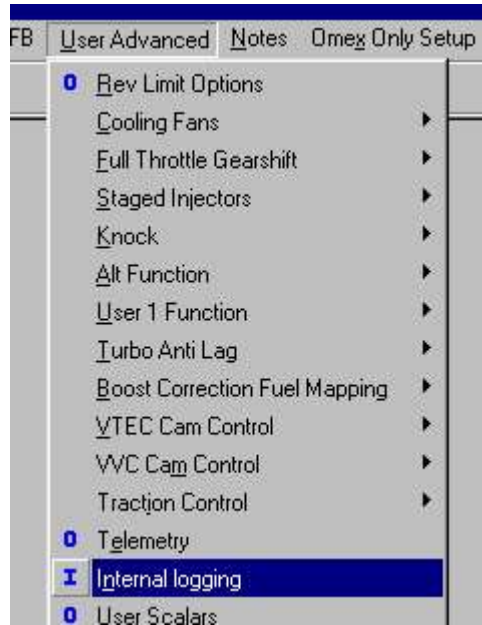
- Air temperature
- Baro pressure
- Battery voltage
- Coolant temperature
- Engine Speed
- Injector duty
- Knock
- Lambda
- MAP
- Throttle position

The PWM output number used is defined by the option **User1 PWM out** and can only be set to AUX1

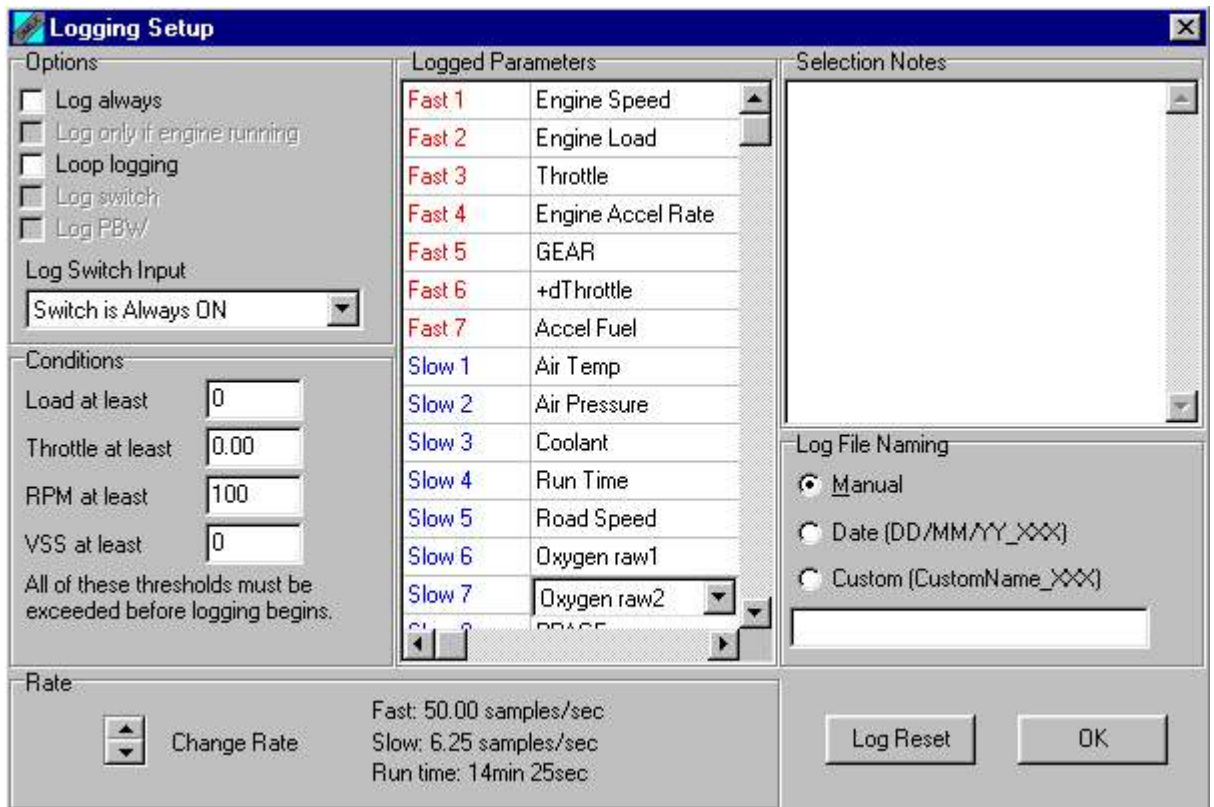
A typical use would be a carbon canister valve drive as part of emission control.  
**User1\_source** = injector duty.



## 26 Internal Data Logging



The internal data logging memory is 512k and varies in time duration dependant upon the logging sample rate. There are 7 fast channels featuring recording rates of up to 250 times per second, and 8 slow channels, the log rate is displayed for the fast and slow channels separately, as well as the time duration that the log rate will allow.



Logging can be triggered to start and stop in many ways.

- **Log Always** –not currently supported.
- **Log Switch** - This allows information to be written to the log memory only when a switch is active. The physical pin for this input switch is set using option **Log Switch Input**.
- **Conditions** - This function allows the user to choose a set of conditions when the logger will start recording.
  - Load>**  
The engine load must exceed this value to activate logging.
  - Throttle>**  
The throttle position must exceed this value to activate logging.
  - RPM>**  
The engine rpm must exceed this value to activate logging.

### Loop Logging

Not currently supported

### Rate

This function allows the user to change the rate at which the selected channels are recorded. The total logging time based on the number and rate of parameters logged will also be displayed here.

### Saving the Datalog

When a log is completed go to **ECU | Download Log Data**. You will then be prompted for a file name and location.

You will then be prompted for notes to be entered. Enter any specific information that pertains to the datalog. ie added 5% fuel, etc. After the information has been entered, click on the close icon “x” box. All notes are then saved with the log file for later viewing using the DATA2000 software.

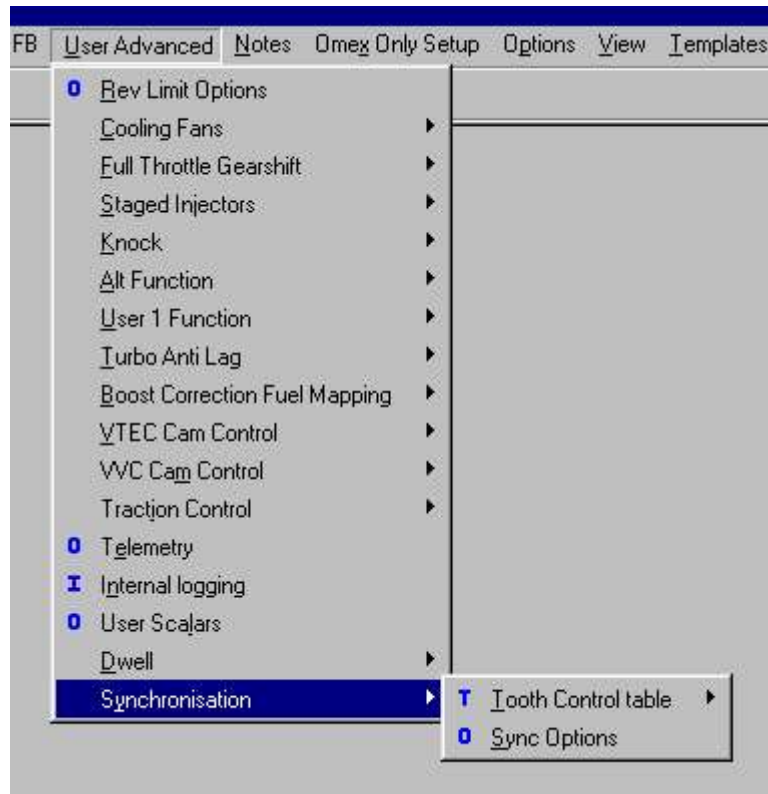
### PC Based Logging

The ECU can also output a datastream to a PC. This would not normally be used as the internal memory is large and can support higher data rates than PC based logging.

To use PC logging:

- Connect to an ECU.
- View the parameters that are to be logged.
- Select **Logging | Start...** **LOGGING** will appear in the status bar to show that MAP3000 is logging.
- Markers can be inserted into the data whilst MAP3000 is logging. These markers appear in the graph window of **DATA2000**. To insert a marker, select **Logging | Insert Marker** or press **Ctrl L**.
- To save the logged data, select **Logging | Stop and Save...** A save file dialog appears prompting for a file name. Depending on the logging options set, a file name may have been automatically created.
- Click the **Save** button to save the data. A window appears, prompting for any notes about the logged data. These notes are saved with the data and are visible within **DATA2000**.
- To stop the logging without saving, select **Logging | Cancel**.

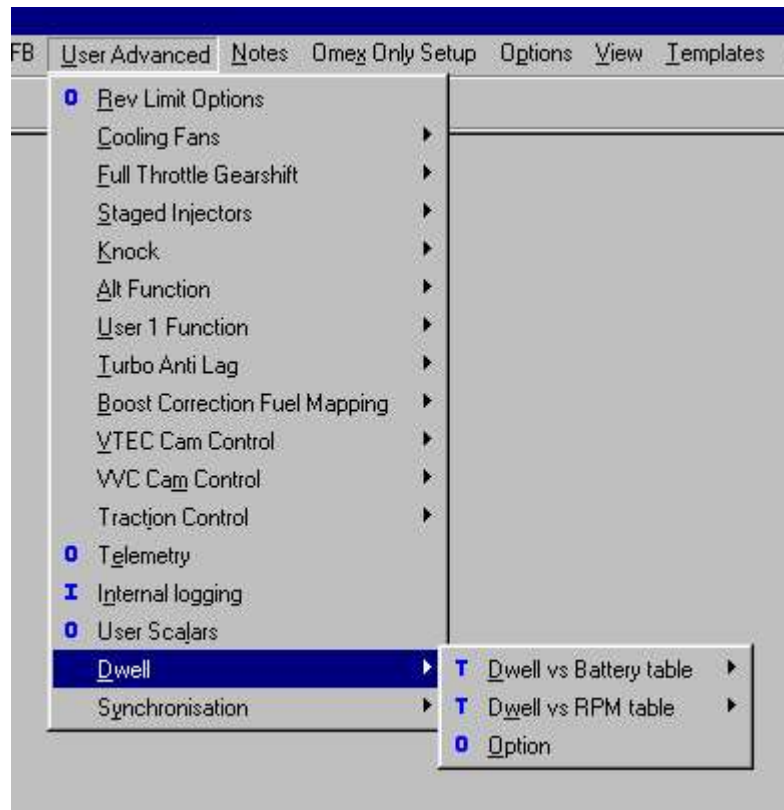
## 27 Synchronisation



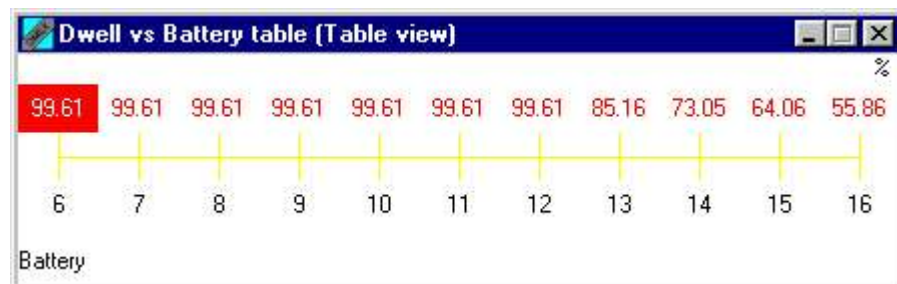
The ECU requires an input of engine position and speed. This is done with a pattern of teeth on the crank pulley. The pattern is generally evenly spaced teeth with missing, extra, or cam teeth as reference points. As different manufacturers use different trigger patterns, the ECU is programmable to suit. The information required in the ECU for many of the popular patterns is already known, some of which are listed below. If you have a different pattern on your engine please contact Omex for advice.

**It is very easy to make an engine run, but not run properly by incorrectly entering these options and tables. Please contact Omex for a new start-up map or email an existing map to Omex to be changed to a different trigger pattern.**

## 28 Dwell Control



The coil dwell time is set by option **Coil Dwell Factor**. This is unitless so contact Omex for typical values. A typical non-amplified DIS coil would have a value of **20**. If the engine required the charge times to be varied with respect to battery voltage or engine speed, it can be done through using the **Dwell vs Battery table** and **Dwell vs Speed table**. Setting these table values to 100% gives a constant dwell time. Typical values are shown below.



The options **Dwell max** and **Dwell min** are the limits of dwell time measured in internal units. Contact Omex if you want to change these values.

## 29 Security

The ECU has security features that allow calibrations to be password protected. All Omex maps are sent with the password cleared to allow all users access to the ECU. If you are using security, clear the password at the beginning of a mapping session and set at the end. If setting a password, keep notes of it and make sure that you have a copy of the last calibration in the ECU.

### Setting a password

When connect to an ECU, a password may be set. To set a password;

- Connect to the ECU
- Select **ECU | Set Password...**
- A dialog box appears prompting for a password. The password may be any alphanumeric 6 character password.



- Enter a password and click **OK**.

### Clearing a password

Once connected to a password protected ECU, the password may be cleared. Clearing the password removes the security such that any PC can connect to this ECU.

To clear the password;

- Connect to the ECU
- Select **ECU | Clear Password...**

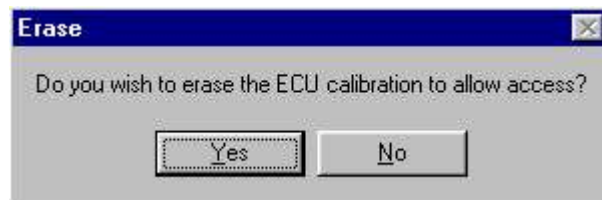
### Clearing a protected ECU

If using an ECU where the password is unknown it is possible to use the ECU. The information in the ECU will be lost so the original map will never be accessed, and the ECU will instead be filled with random numbers.

- **ECU | Connect**
- A dialog box appears prompting for a password.



- As the password is unknown click **Cancel**.
- A dialog box appears asking if you wish to erase the calibration to allow access. Click **Yes**.



- The PC will now write random values to the ECU, and connect.
- **ECU | Send new calibration.** Select your new start-up map.
- Clear the password as shown above.

## 30 Wiring

### 30.1 Semi Assembled Loom Construction

The engine bay is a harsh environment for wiring harnesses with oil, water, solvents, high temperatures, high vibration, and high electrical noise. The semi-assembled wiring harness is made from automotive grade cable and the shielded cables are already made-up at the ECU connector to prevent electrical noise problems.

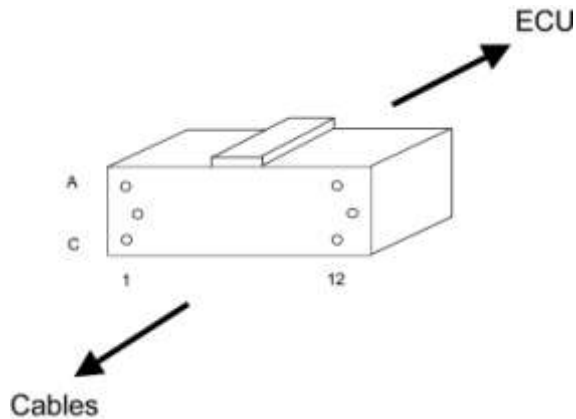
The following should be noted when constructing the loom;

- The ECU should be mounted away from sources of extreme heat (such as exhaust), and away from direct water spray.
- The connector terminals should be either crimped with the correct tool or crimped and soldered.
- The looming material holding the wires in the loom should totally cover the wires to prevent chaffing of the wire insulation.
- If the loom is to go through panels, grommets should be used.
- The loom should be tied to mounting points using cable ties or p-clips to limit the additional stresses of the loom moving.

### 30.2 ECU Connector Pins

It is occasionally necessary whilst fault finding to trace through your wiring harness to check continuity. The following are the pin-outs for the ECU plug as found on the end of the wiring harness. Where there are two colours, the first is the main colour and the second is the tracer eg

Yellow violet – yellow with violet tracer



number	colour code	output name
1A	Yellow black	IGN1
2A	Yellow violet	IGN6
3A	Brown pink	FUEL8
4A	Red	Battery power
5A	Black	Power ground 1
6A	Grey	Sensor ground
7A	Black screened red	Crank sensor
8A		Timing ground
9A	White violet	Coolant temperature sensor
10A	White yellow	MAP2
11A	Red screened red	Cam Sensor
12A	Yellow grey	IGN2
1B	Yellow orange	IGN4
2B	Yellow green	IGN5
3B	Brown violet	FUEL6
4B	Brown black	FUEL1
5B	Brown green	FUEL5
6B	Blue white	MAP1
7B	Black	Power ground 2
8B	Brown grey	FUEL7
9B	White green	Air temperature sensor
10B	Grey screened	Knock sensor
11B	White orange	Oxygen sensor 2
12B	Yellow red	IGN3
1C	Blue grey	HIGHSIDE2
2C	Brown orange	FUEL4
3C	Brown yellow	FUEL2
4C		
5C	Blue black	HIGHSIDE1
6C	Brown red	FUEL3
7C	White red	Oxygen sensor 1
8C	Orange	Throttle position sensor
9C	Pink	5V out
10C	Blue screened red	Road speed sensor
11C	White pink	ALT POWER
12C	Blue yellow	Tacho

### 30.3 Component Pin-outs

<b>Throttle Position Sensors (TPS)</b>			
<b>Omex Part Number</b>	<b>Description</b>	<b>Pins</b>	<b>Omex Wire Colour</b>
OMEM2001	General Purpose	1 Signal (green) 2 +5v (red) 3 Sensor Earth (Black)	Orange Pink Grey
OMEM2005	Jenvey	1 Signal (red) 2 +5v (Green) 3 Sensor Earth (yellow)	Orange Pink Grey

<b>MAP Sensors</b>			
<b>Omex Part Number</b>	<b>Description</b>	<b>Pins</b>	<b>Omex Wire Colour</b>
OMEM2001	1 Bar	1 Signal	Grey Pink
OMEM2002	2 Bar	2 Sensor Earth	
OMEM2003	3 Bar	3 +5v	

<b>Coils</b>			
<b>Omex Part Number</b>	<b>Description</b>	<b>Pins</b>	<b>Omex Wire Colour</b>
Sagem / Valio Coil OMEM3501	4 Cyl DIS	1 Ign 1 2 Ign 2 3 +12v Supply 4 n/f	Switched
Ford Coil OMEM3503	4 Cyl DIS 3 pin	1 Ign 1 2 +12v 3 Ign 2	Switched

<b>Temperature Sensors</b>			
<b>Omex Part Number</b>	<b>Description</b>	<b>Pins</b>	<b>Omex Wire Colour</b>
OMEM2200	Coolant Temp (CTS)	1 Sensor Out 2 Sensor Earth	White / Violet Grey
OMEM2201	Air Temp (ATS)	1 Sensor Out 2 Sensor Earth	White / Green Grey

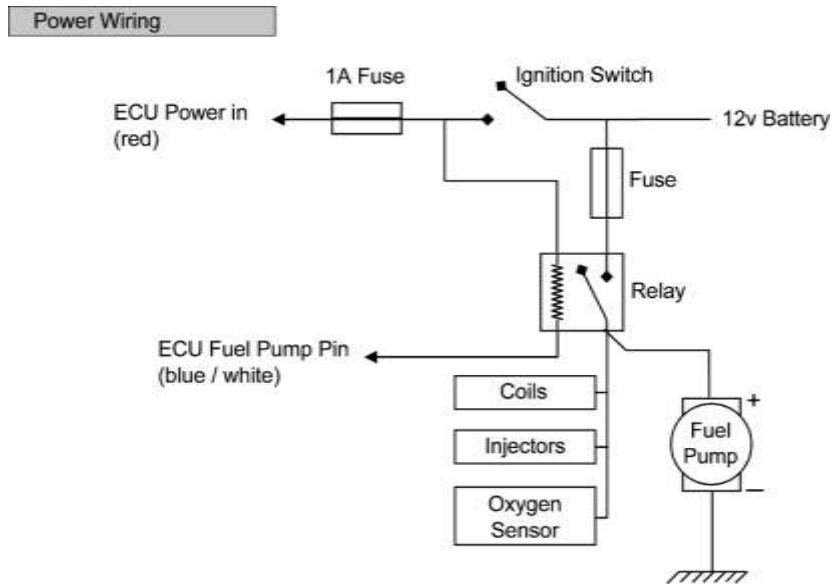
<b>Crank Position Sensors (CPS)</b>			
<b>Omex Part Number</b>	<b>Description</b>	<b>Pins</b>	<b>Omex Wire Colour</b>
OMEM2401	2 hole mounting	1 Sensor Out 2 Sensor Earth	Black screened red Black screened blue

<b>Oxygen (Lambda) Sensors</b>			
<b>Omex Part Number</b>	<b>Description</b>	<b>Pins</b>	<b>Omex Wire Colour</b>
OMEM2300	4 wire	Sensor Out (Black) Sensor Earth (Grey) Heater (White) Heater (White)	Grey +12v Switched Earth

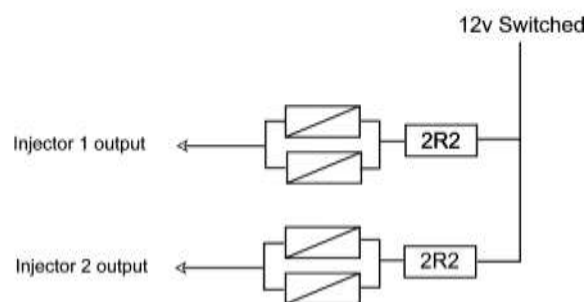
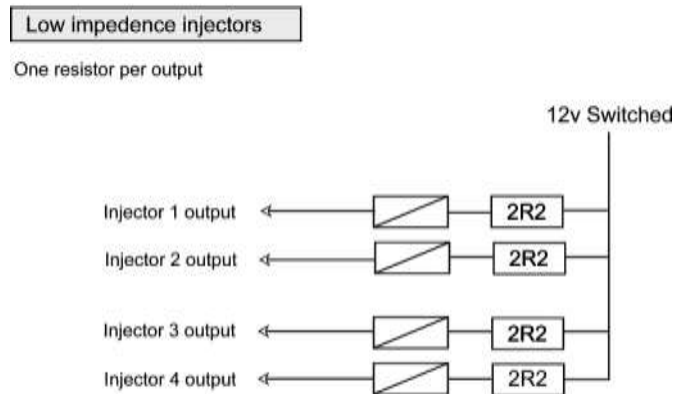
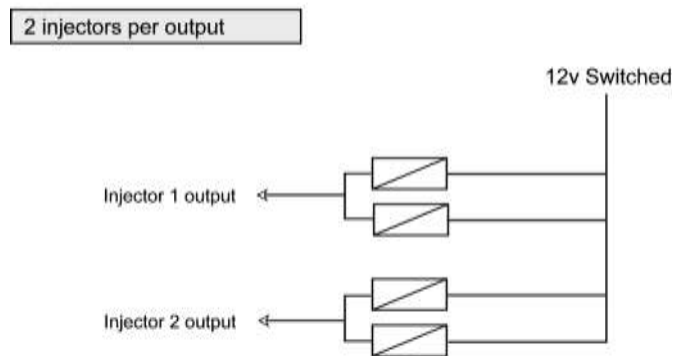
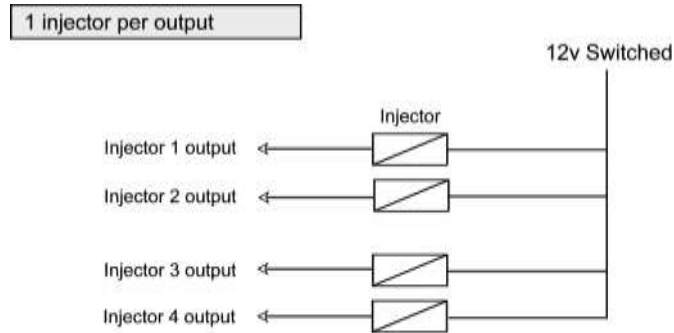
### 30.4 Diagrams

The diagrams section shows how various inputs, outputs etc should be wired.

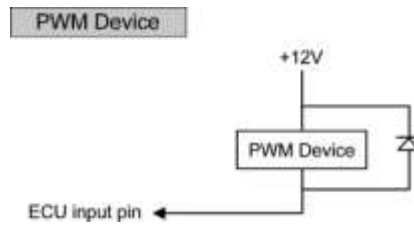
To switch power to the coils, injectors etc based on the fuel pump output from the ECU, typically,



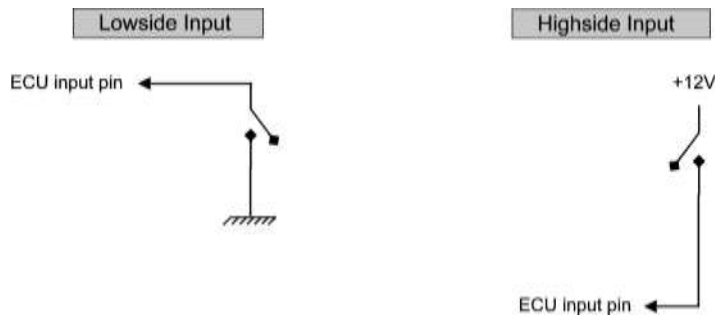
The following diagram shows examples of how injectors should be wired for a 4 cyl engine. Firstly is the case of one injector per output ie sequential fuelling, then two injectors per output ie semi-sequential. When paired, you should ensure that the correct injectors are joined. If standard 4 cyl firing of 1342, then 1+4 should be paired, and 2+3. If the injectors have an impedance of less than 6ohms they require ballast resistors. Each ballast resistor should cover two injectors only.



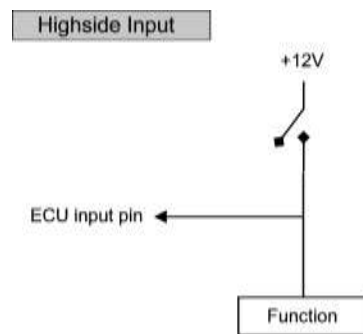
PWM devices driven from the FUEL1-8 outputs require a diode between their output and power.



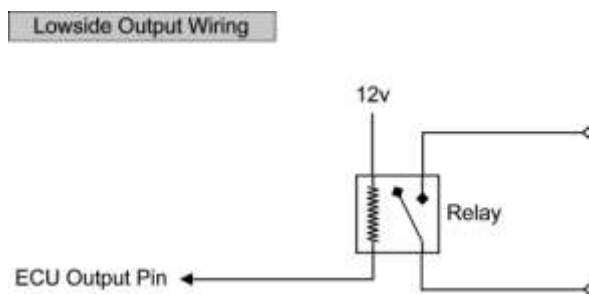
There are two types of input for the ECU, highside and lowside. Most inputs are highside. Contact Omex for advice.



If an input is to be switched at the same time as something physical eg a solenoid for ALS, then the physical input switch can both turn on the solenoid and give an input to the ECU.



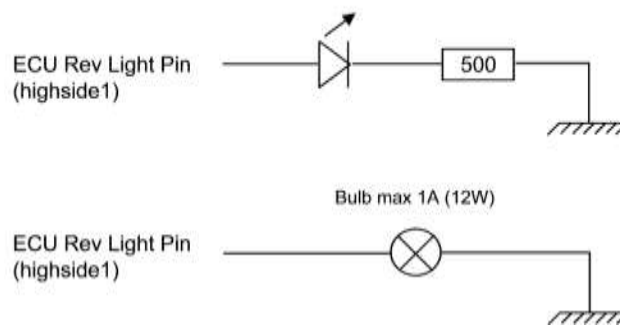
The lowside outputs are unable to directly earth a large current, so they should be used with a relay



Highside Output Wiring



Highside Shiftlight Wiring



The tacho output if used is a lowside switch so replicates a coil negative pulse.

Tacho Wiring

