

OMEM 200

Hardware Instructions

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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 OMEM200 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 calibration 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 the CD or floppy disk 1 into the 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 | Baud Rate** set to **38400**
- **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 of the sensor inputs. Check that these are all showing sensible numbers.

Ignition Timing

The ECU recognises the engine position by a missing or extra tooth on a pattern of evenly spaced 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

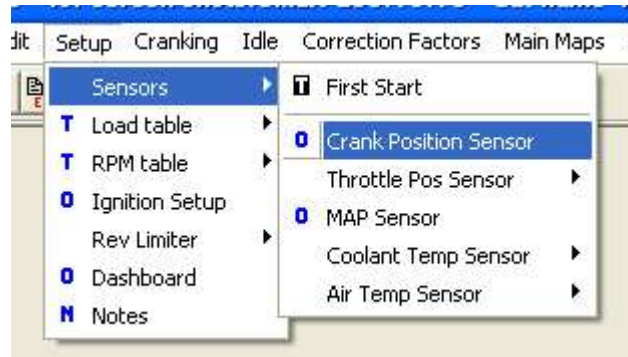
will need to find this value yourself. To find this value you will need a strobe light and an accurate TDC mark on the engine.

- Press the start button 
- Hold the engine at 2000-3000 rpm (ie out of the idle condition 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 a 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 Setup

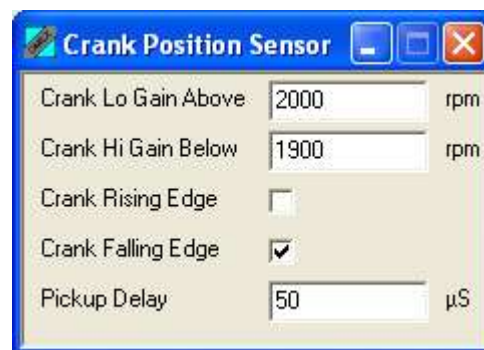
3.1 Sensors

3.1.1 Crank Sensor



The ECU needs to know engine speed and position in order to supply the correct 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

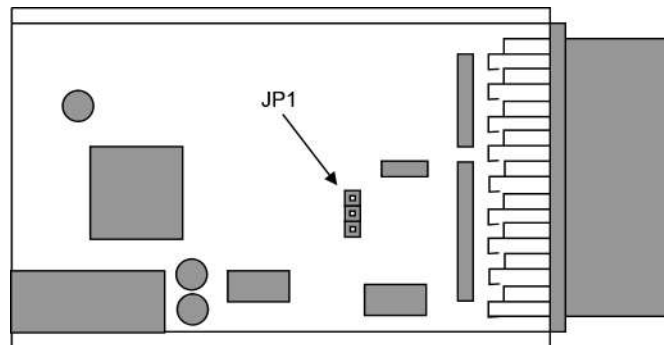
Many older engines do not have a trigger wheel. In this is the case an external wheel must be fitted. Contact Omex for suggested trigger patterns. There is a minimum diameter for these wheels dependent on the sensor used, the trigger pattern, and the engine operating speeds. Contact Omex for advice. 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 Quick Start section of this manual 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.

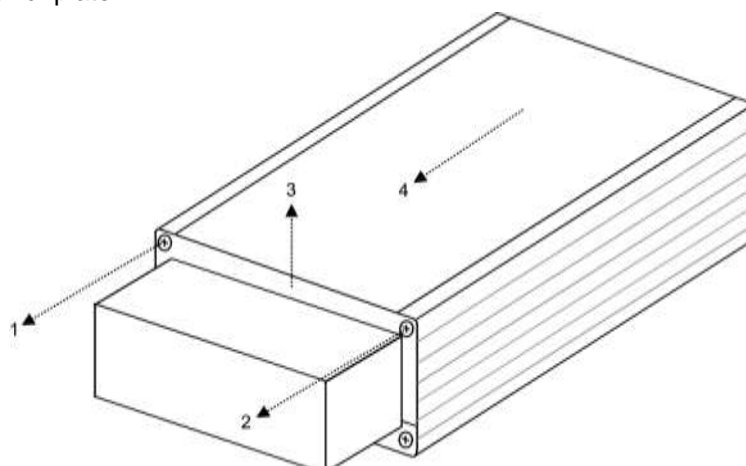


Crank sensor (JP1)

Sensor Type	
Typical MVR	
High Output MVR	
Hall Effect	

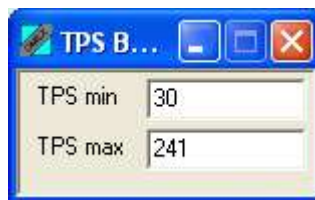
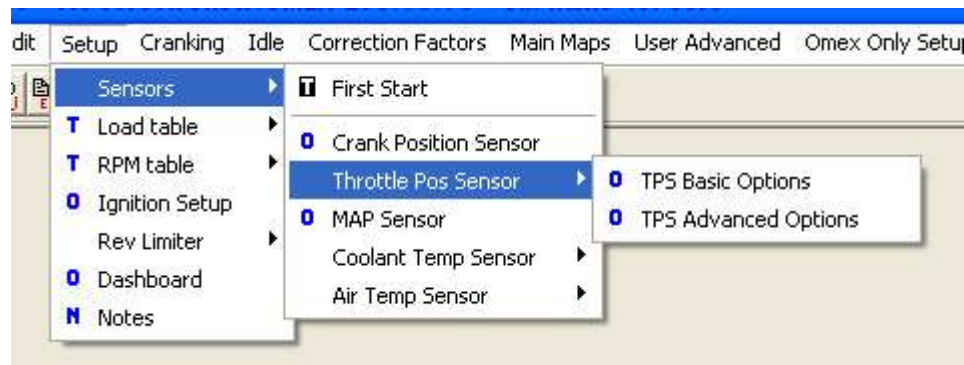
To change the jumpers you will need to part-disassemble the ECU to gain access to the board. As shown in the diagram;

- remove screws 1 and 2
- slide up the end plate 3
- slide off the lid plate 4



3.1.2 Throttle Position Sensor

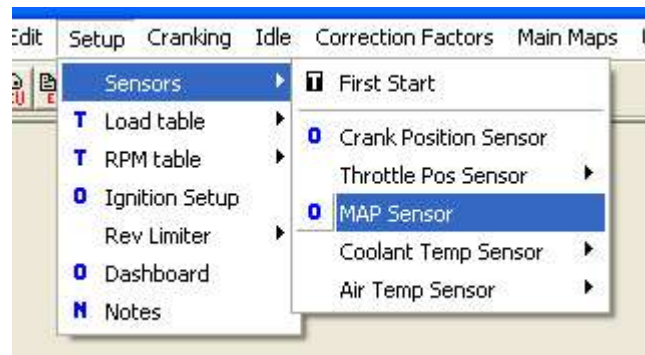
The ECU needs an input of engine load if it going to give three-dimensional mapping. The Omex ECU can use an input of throttle position (TPS) or manifold absolute pressure (MAP). Most normally aspirated engines will use an input of throttle position as this gives excellent throttle response. Forced induction engines need to use MAP 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. Some race series state that a load sensor may not be used and this is fine, the ECU will still work and will only reference the full-load line of the ignition map.

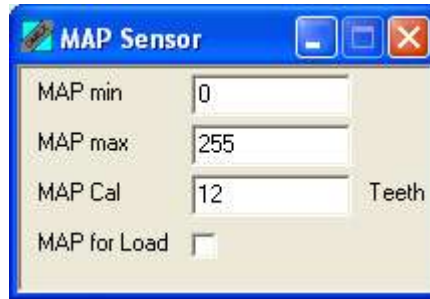


The parameter **TPS raw** gives the raw number output of the sensor which is scaled by options **TPS min** and **TPS max** to give a throttle that works between 0 and 100. To calibrate, see Quick Start section of this manual.

3.1.3 MAP Sensor

The ECU needs an input of engine load. The Omex ECU can use an input of throttle position (TPS) or manifold absolute pressure (MAP). Most normally aspirated engines will use an input of throttle position as this gives excellent throttle response. Forced induction engines need to use MAP 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.





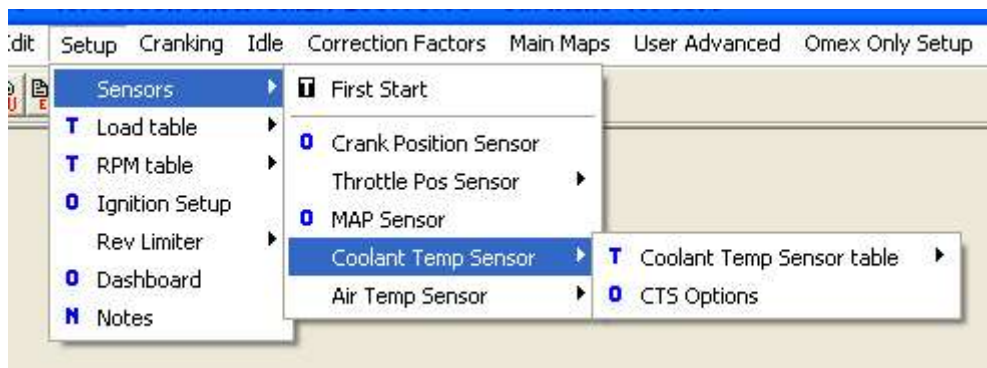
An external three wire 0 - 5 V output MAP sensor can be used to sense engine load. MAP sensor ratings are absolute rather than boost pressure so 1bar is for normally aspirated (NA) non-boosted engines and barometric compensation, 2bar for up to 1bar boost, 2.5bar for up to 1.5bar boost, and 3bar for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

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

MAP min and **MAP max** will only need changing from **0** and **255** if you are using an oversized MAP sensor. If this is the case then contact Omex for advice.

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

3.1.4 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 varying temperature 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 but you may need to calibrate your sensors.

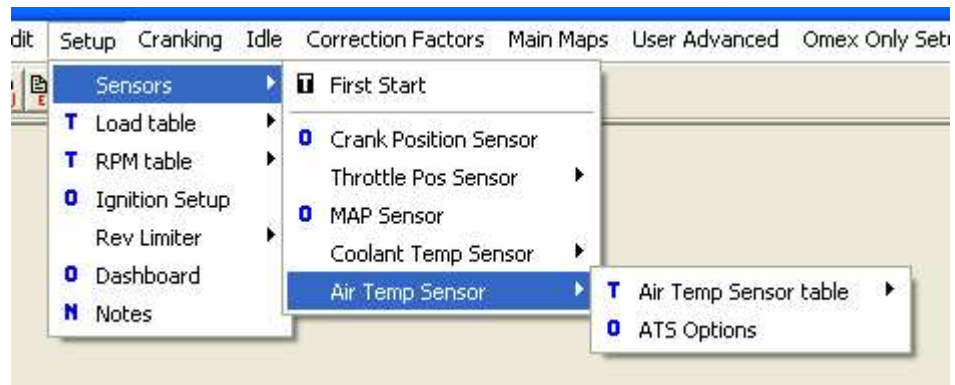
To calibrate a sensor;

- **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.



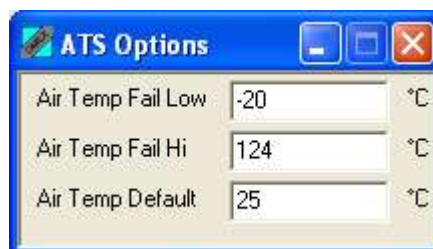
Coolant Fail Low and **Hi** are the failure points of the sensors. Example- If the minimum readable temperature of a sensor is –25 then **Coolant Fail Low** should be set at –24. If the maximum readable temperature of the sensor is 125 then **Coolant Fail Hi** should be set to 124. **Coolant Temp Default**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

3.1.5 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 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 **Air Temp Sensor table**. The values for many sensors are known but you may need to calibrate your sensors.

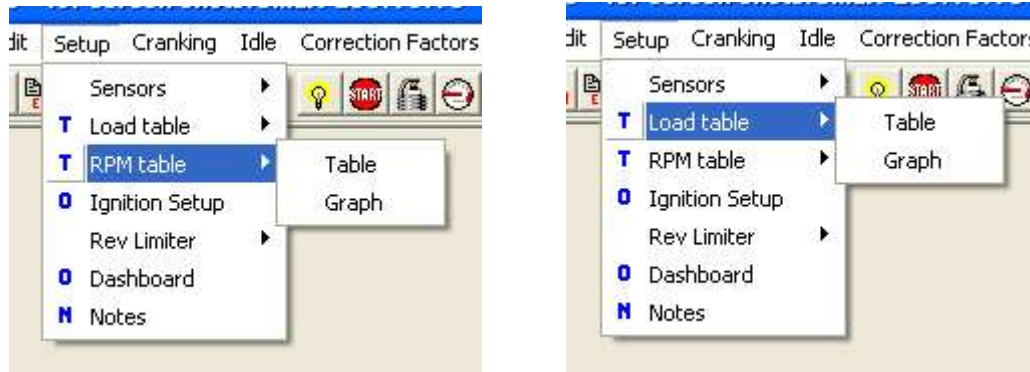


To calibrate your sensor, see the calibration of the coolant temperature sensor.

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.

3.2 Map axes

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



3.3 Ignition Setup

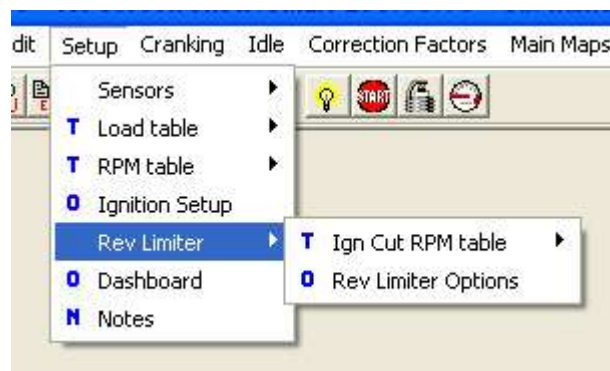


Ignition timing is controlled by a map of numbers. There are 11 load sites and 21 speed. These sites can be set in the **Load Table** and the **RPM Table**. Interpolation is used between sites to ensure smooth curves.

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.

As the reference point (missing or extra 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 the reference point is. The option **Timing Alignment** describes this and can be adjusted to suit each trigger wheel type. A change in value of 1 gives a change in timing position of 30 degrees. The correct numbers are known for many popular manufacturers. Please contact Omex for advice.

3.4 Rev Limits



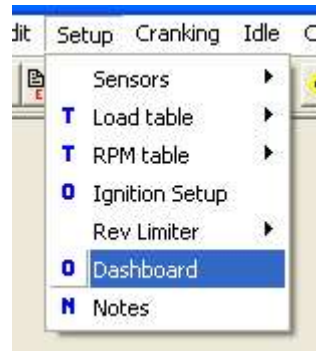
The table Ign Rev Limit sets the engine speed limit, set all of the throttle positions in the table to the same engine speed. An example of a 6000rpm limit is as follows.



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.



3.5 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.

4 Engine Start Condition

During cranking, the ignition is not controlled by the main ignition map, but instead by separate options.

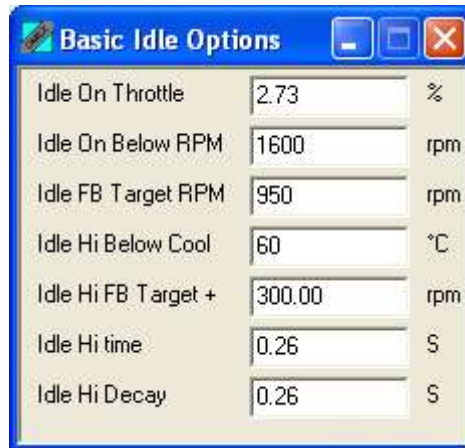


The cranking condition is defined by the engine speed options **Min RPM** and **Start Exit RPM**. **Min RPM** is the engine speed at which the engine is considered to start cranking (typically 50 rpm), and **Start Exit RPM** is the engine speed above which the engine is considered to be under normal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

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.

5 Idle Strategies

The 200 series ECU can control idle using spark scattering.



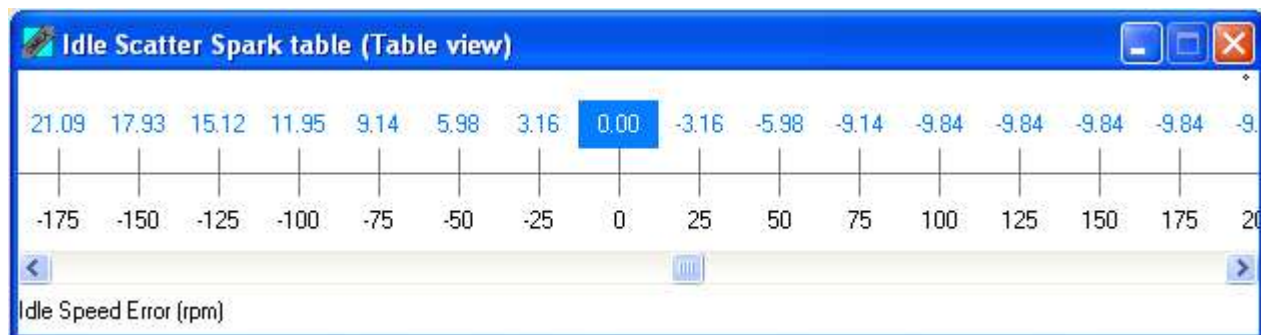
The idle condition is entered by the options **Idle on Below RPM**, and **Idle Below Throttle**. The engine condition must be below both of these two values to enter idle.

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**.

5.1 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.



6 Correction Factors

6.1 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**.

6.2 Air Temperature

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**.

36-1 Omex



Tooth Control table same as Ford.

60-2 Bosch

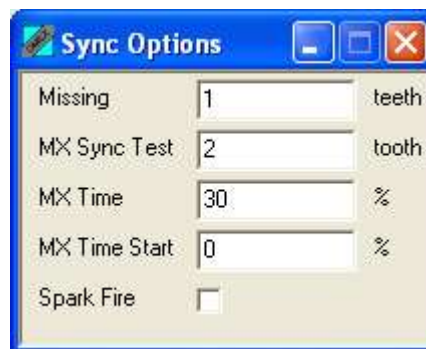


Tooth Control table:

5 4 4 4 4 5 4 4 4 4 5 4 4 4 4 5 4 4 4 4 5 4 4 4 4 5 4 4 4 4
 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

5 4 4 4 4 5 4 4 4 4 5 4 4 4 4 5 4 4 4 4 5 4 4 4 4 5 4 4 3 3
 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59

Rover K-Series

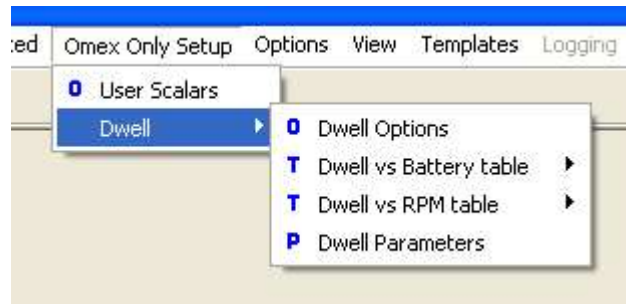


Tooth Control table:

4 4 5 4 4 5 4 4 5 4 4 5 4 5 4 5 4 4 5 4 4 5 4 4 5 4 4 5 4 5
 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

4 5 3
 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59

8 Dwell Control Advanced



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.

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.

9 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...**

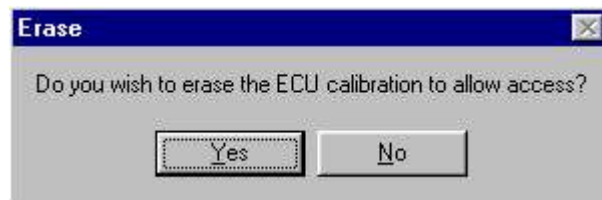
Clearing a protected ECU

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.

10 Wiring

10.1 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.

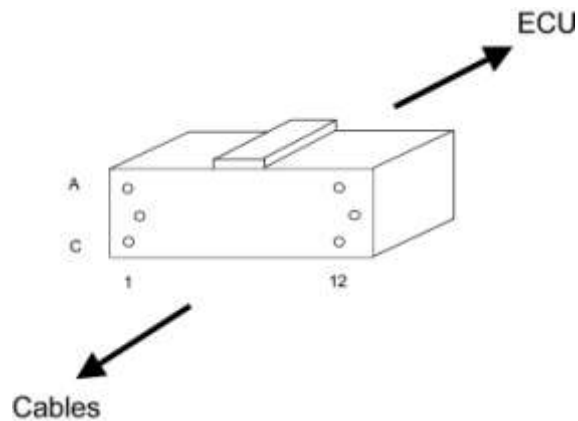
The following should be noted when constructing the loom;

- 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.

10.2 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	function
1A	Violet	Ignition 1
2A		
3A		
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		
11A		
12A	Yellow	Ignition 2
1B		
2B		
3B		
4B		
5B		
6B	Green	MAP sensor
7B		
8B	Blue grey	Shift light
9B	Green white	Air temperature sensor
10B		
11B		
12B		
1C		
2C		
3C		
4C		
5C		
6C		
7C		
8C	Orange	Throttle position sensor
9C	Pink	5V out
10C		
11C		
12C	Blue yellow	Tacho

10.3 Component Pin-outs

Throttle Position Sensors (TPS)			
Omex Part Number	Description	Pins	Omex Wire Colour
OMEM2001	General Purpose	1 Signal (green) 2 +5v (red) 3 Sensor Earth (Black)	Orange Pink Grey
OMEM2002 OMEM2003	DCOE Carbs	1 Signal 2 Sensor Earth 3 +5v	Orange Grey Pink
OMEM2004	DHLA Carbs	1 Signal 2 Sensor Earth 3 +5v	Orange Grey Pink
OMEM2005	Jenvey	1 Signal (red) 2 +5v (Green) 3 Sensor Earth (yellow)	Orange Pink Grey

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

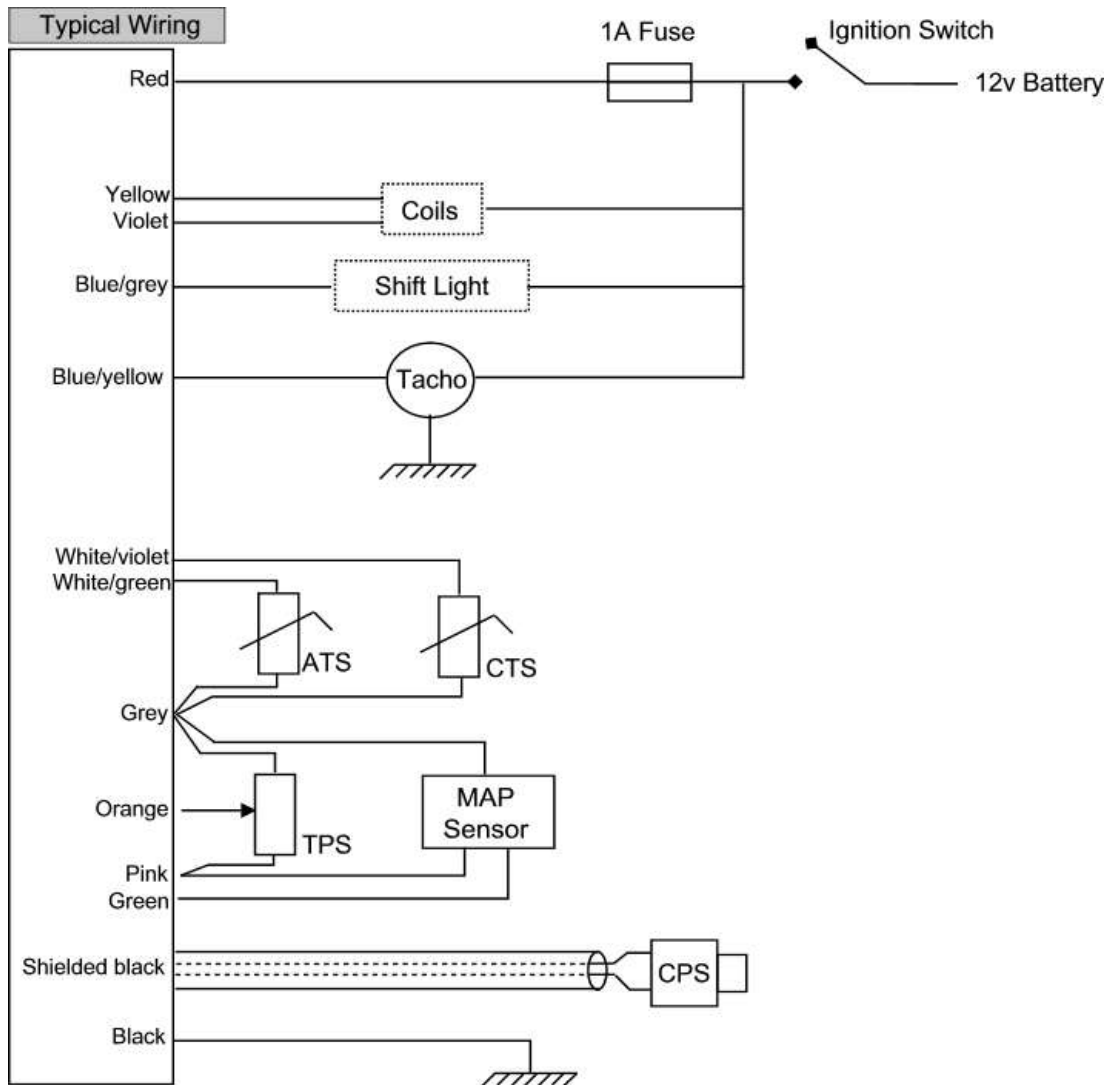
Coils			
Omex Part Number	Description	Pins	Omex Wire Colour
Single coil	Single coil	+ve +12V Supply -ve Ign1 and Ign2	Switched Violet and Yellow
Sagem / Valio Coil OMEM3501	4 Cyl DIS	1 Ign 1 2 Ign 2 3 +12v Supply 4 n/f	Violet Yellow Switched
Ford Coil OMEM3503	4 Cyl DIS 3 pin	1 Ign 1 2 +12v 3 Ign 2	Violet Switched Yellow

Temperature Sensors			
Omex Part Number	Description	Pins	Omex Wire Colour
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

Crank Position Sensors (CPS)			
Omex Part Number	Description	Pins	Omex Wire Colour
OMEM2401	2 hole mounting	1 Sensor Out 2 Sensor Earth	Red Screened Black Screened

10.4 Diagram

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



Shift Light

The shiflight output can control either an LED or bulb. LEDs assemblies are available from Omex. If you are to use a bulb, the maximum current draw should be 1A.