



# 200 Series ECU

## Installation Manual

OMEM200

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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 installing the OMEM200 ECU. It is essential that the user reads the whole of the manual before attempting to install the system. 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 then please contact Omex for help.

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.

## 2 Standard Functions

### 2.1 Crank Position Sensor (CPS)

#### Trigger Wheel

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 measured using a pattern of teeth on a crank wheel or flywheel (known as a trigger wheel). The 200 ECU supports the following patterns;

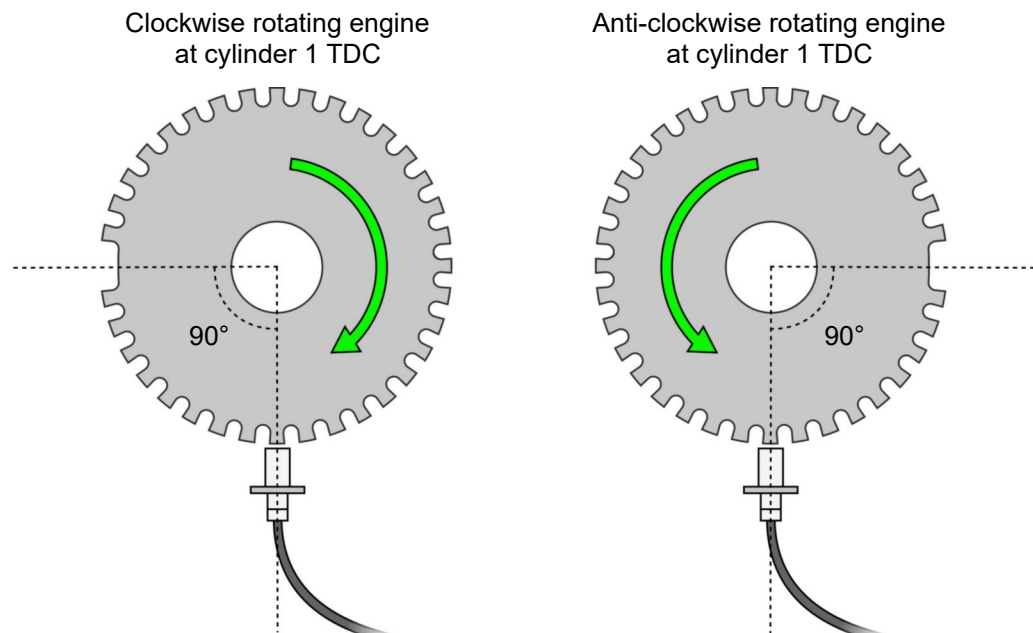
|                |                                              |
|----------------|----------------------------------------------|
| Ford 36-1      | Rover 18-1, 18-1 (distributor ignition only) |
| Bosch 60-2     | Toyota 36-2                                  |
| Rover K (late) | Honda 12+1                                   |

If you have any doubt as to whether the trigger pattern on your engine is supported by the 200 ECU, then remove the sensor, count the pattern of teeth, and contact Omex.

Many older engines do not have a trigger wheel. In this case an external wheel must be fitted. 36-1 is our preferred pattern. There is a minimum diameter for these wheels dependent on the sensor used, the trigger pattern, and the engine operating speeds. Typically the larger the trigger wheel diameter the better. 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 and if the crank pulley has a damper inbuilt you must mount the trigger wheel onto the crank side of this damper. Omex can supply general purpose trigger wheels in diameters of 100mm and 140mm.

If installing a trigger wheel of missing tooth type,

- Accurately mark TDC.
- Mount your crank position sensor (CPS) anywhere around the perimeter of the trigger wheel pointing towards the centre of the wheel such that the sensor can touch the pulley (it will be spaced out so that it does not touch later). The mount should be strong enough that you can lean on it and it not move.
- Mount the trigger wheel so that the missing tooth is approximately 90 degrees after the crank sensor. (the exact angle can be adjusted in software but for first start of the engine it helps if you are within 10 degrees of this position). If the crank pulley has a damper inbuilt you must mount the trigger wheel onto the crank side of this damper.
- Run the crank pulley / trigger wheel assembly in a lathe to ensure that the trigger wheel is exactly central on the pulley.
- Refit the pulley / trigger wheel assembly and adjust the sensor-to-wheel gap to 0.3mm-0.5mm by spacing out the sensor with shims.
- Rotate the pulley and ensure that the gap does not alter by more than 0.2mm.



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.

## Sensor

There are two types of crank position sensor; MVR and Hall Effect. The Hall Effect type require ignition switched power to make them work.

2 wire sensors must be MVR. Usually terminal 1 is the signal and terminal 2 the timing ground

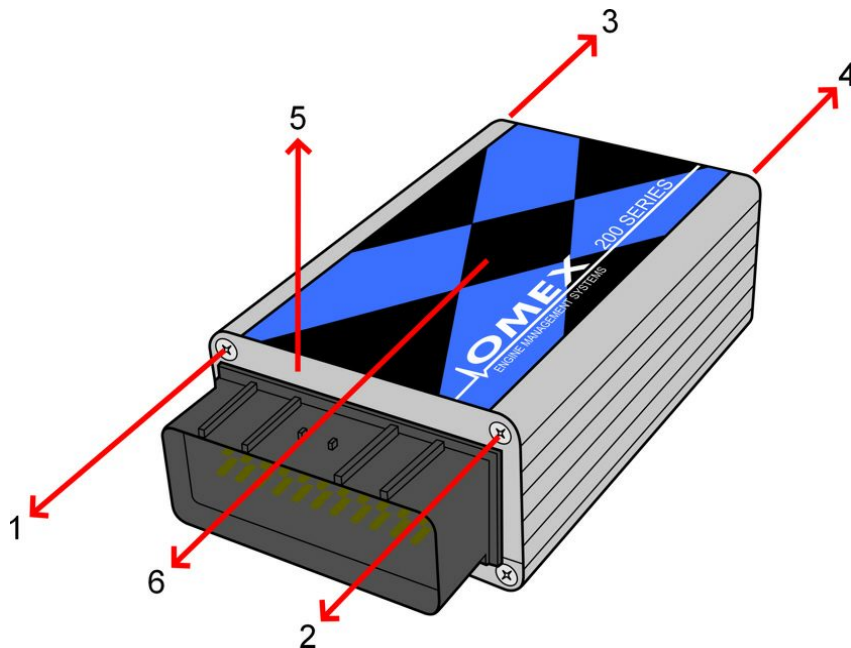
3 wire sensors can be either MVR or Hall Effect. If MVR, then usually terminal 1 is the signal, terminal 2 the timing ground and terminal 3 has no connection. If Hall Effect, there is no way of measuring externally to find which pin has which function; you must find out from the manufacturer.

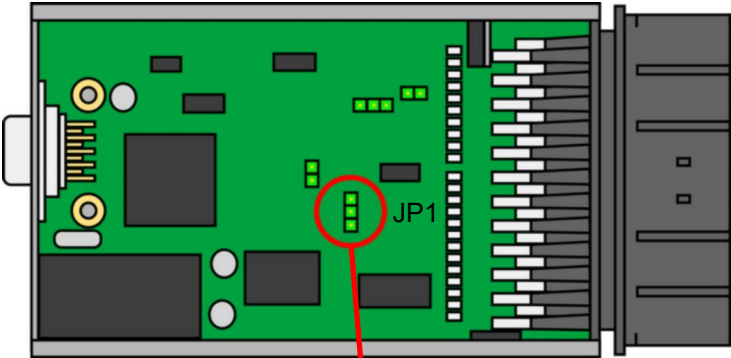
If the sensor is Hall Effect, a jumper (supplied with the ECU) must be put onto header pins on the ECU board.

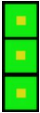


To fit this part you will need to part-disassemble the ECU to gain access to the board. As shown in the diagram;

- remove screws (1, 2, 3 and 4)
- slide up the end plate (5)
- slide off the lid plate (6)





| Sensor Type | Jumper Position                                                                               |
|-------------|-----------------------------------------------------------------------------------------------|
| MVR         |  no jumper |
| Hall Effect |          |

## 2.2 Throttle Position Sensor (TPS)

The addition of a throttle position sensor allows varying ignition timing with changes in engine load; similar to a 'vacuum advance'. This sensor must be placed on the end of the throttle spindle.

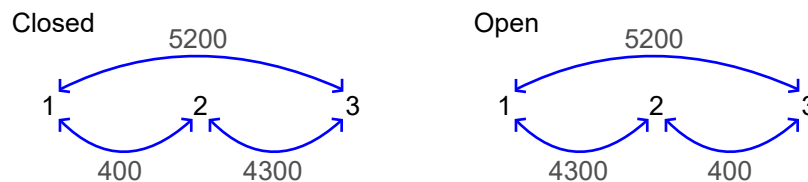
### Pin-outs

If you have purchased a throttle position sensor from Omex, then the pin-outs for your sensor can be found on the information sheet with the sensor. If you are using an unknown sensor then you will need to test the potentiometer to find this information.

Allocate the sensor terminals with numbers 1,2,3. With the sensor disconnected from any wiring use a multimeter on the resistance setting ( $k\Omega$ ) to measure the resistance between each of the terminals with the throttle in an approximate closed position and then with the throttle in an approximate open position (the absolute position is not important).

Between two of the terminals the resistance will not change as the throttle is opened. This tells us that the remaining terminal is the signal (Omex orange cable). From the remaining two terminals, one of them will have a resistance to the signal that is lower when throttle open than when throttle closed, this is the 5V reference voltage terminal (Omex pink cable). The last terminal must therefore be the sensor 0V (Omex grey cable).

Example;



When the throttle position is moved from closed to open, the resistance does not change between 1 and 3. Therefore, 2 must be the signal (Omex orange). 3 has the lower resistance to the signal with the throttle open and so must be the 5V (Omex pink), leaving 1 to be the sensor 0V (Omex grey).

## 2.3 Coolant Temperature Sensor

The coolant temperature sensor is required to give the ECU information on the temperature of the engine's coolant, allowing corrections for extreme cold and hot running.

This sensor is optional as this control is only required on engines that are particularly sensitive to coolant temperature changes.

### 1 wire Sensor

These sensors are for dashboard coolant gauges and cannot be used with the ECU.

### 2 wire Sensor

These sensors are correct for use with the ECU. The two wires from the ECU can go either way round on the terminals.

### 3 wire Sensor

These rare coolant temperature sensors are a 1 wire sensor and a 2 wire sensor in one package. The 1 wire part is for the vehicle's dashboard coolant gauge and the 2 wire part is for the ECU. You can find the correct terminals using a multimeter continuity test. The terminal for the dashboard coolant gauge has connection to the metal body of the sensor. The two terminals for the ECU connection do not. The two wires from the ECU can go either way round on the two applicable terminals.

## Dashboard Coolant Gauge

A gauge cannot be connected onto the sensor being used for the ECU. The gauge must have its own separate sensor supplied by the gauge manufacturer.

## Retro-fitting

If fitting a sensor to an engine that does not have one as standard, the sensor must be fitted to the engine side of the thermostat so that it sees the engine's coolant temperature even when the thermostat is closed. Omex can supply suitable sensors.



## 2.4 Air Temperature Sensor (ATS)

The air temperature sensor is used to give the ECU information on the temperature of the inlet air. This allows corrections to the ignition timing to suit varying conditions.

This sensor is optional as this control is only required on engines that see large temperature changes, typically only forced induction engines.

The air temperature should be measured as close to the inlet as possible, preferably in the inlet airbox, the back of the airfilter, or with forced induction engines, in the inlet plenum. Heat-soak into the body of the air temperature sensor needs to be minimised so it is preferable when installing the sensor into an inlet plenum to install it onto a non-metallic section of the inlet. If this is not possible, then a pipe just before the throttle plate that is insulated from the direct conduction of engine temperature can be used.

The two wires can go onto the sensor either way round.

## 2.5 Manifold Absolute Pressure (MAP)

Forced induction engines need a MAP sensor to give the ECU a reading of manifold pressure (boost pressure). In some cases a MAP sensor is used to measure engine load on NA engines but this is rare.

MAP sensor ratings are absolute rather than boost pressure so 1bar is for normally aspirated (NA) non-boosted engines, 2bar for up to 1bar boost, 2.5bar for up to 1.5bar boost, and 3bar for up to 2bar boost.

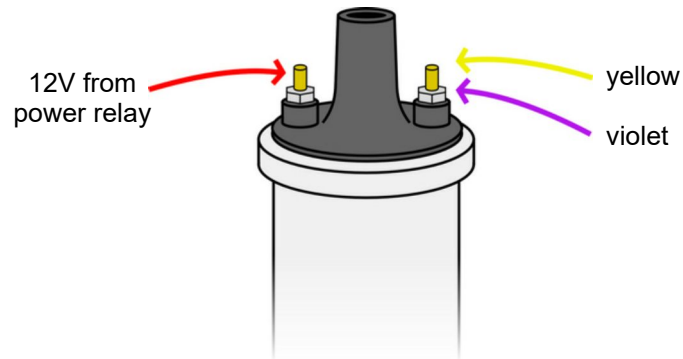
The MAP sensor will be joined to the inlet plenum by a small diameter tube.

It is not possible to find which wiring terminal has which function externally so this information must come from the manufacturer of the component.

## 2.6 Ignition Coil(s)

The ECU is fitted with two amplified ignition outputs. This allows the following types of ignition;

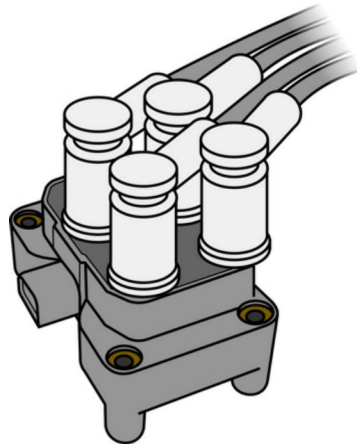
### Single Coil and Distributor



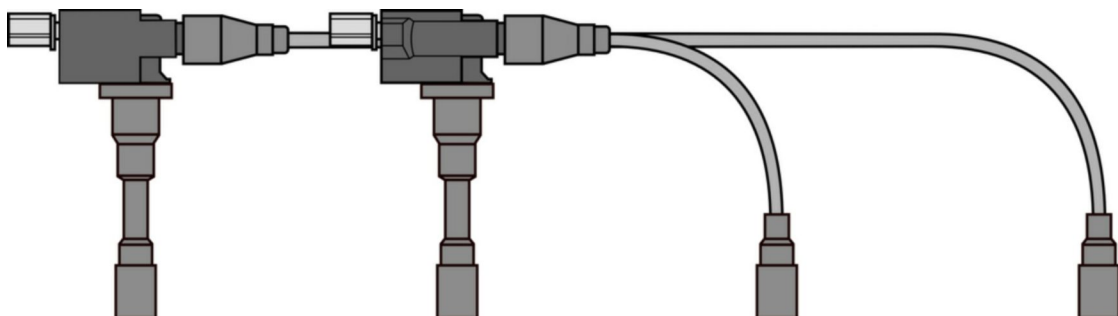
Both ignition outputs from the ECU go onto the coil negative terminal. The distributor can be left as standard but all that is now used are the rotor arm and cap; the advance mechanisms, points etc are redundant.

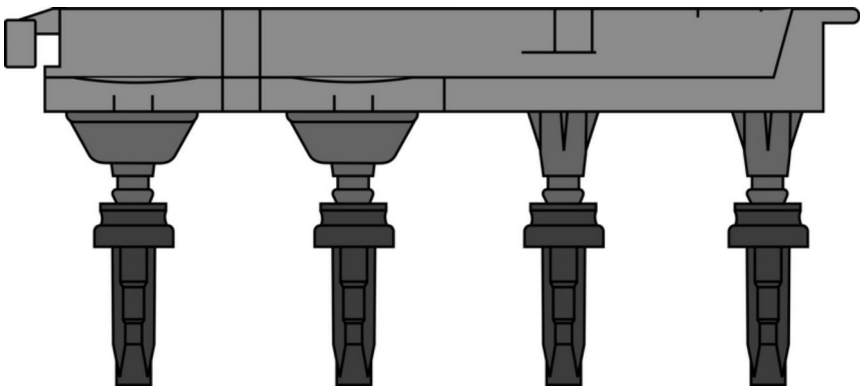
### Wasted Spark Coil Pack

These are typically a single pack containing two double-ended coils with 4 HT leads coming directly from it.



Some engines have wasted spark coil packs that look like 4 individual coils, but are still two double ended coils and so can still be controlled directly by the ECU. Examples are some Rover K Series and some small Peugeot engines;





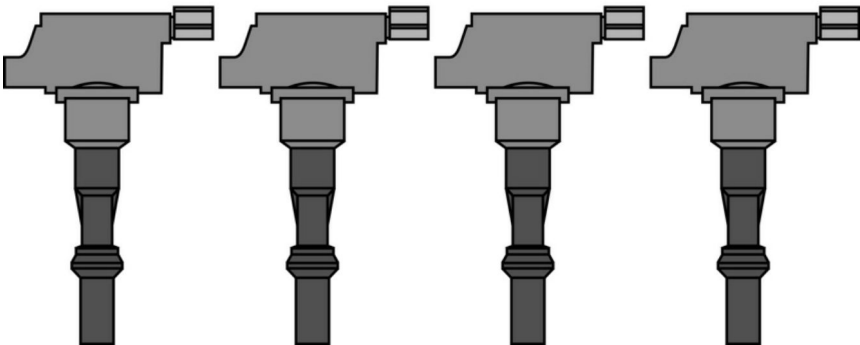
The coil should be non-amplified. You can test this by measuring with a multimeter (resistance setting). Between the 12V terminal and one of the signal terminals (also known as coil negative) a non-amplified coil will measure approximately 1Ω. An amplified coil pack will measure several kΩ. Amplified coil packs can be used if necessary, but are not ideal and the ECU hardware must be modified by Omex to allow this.

Known wiring

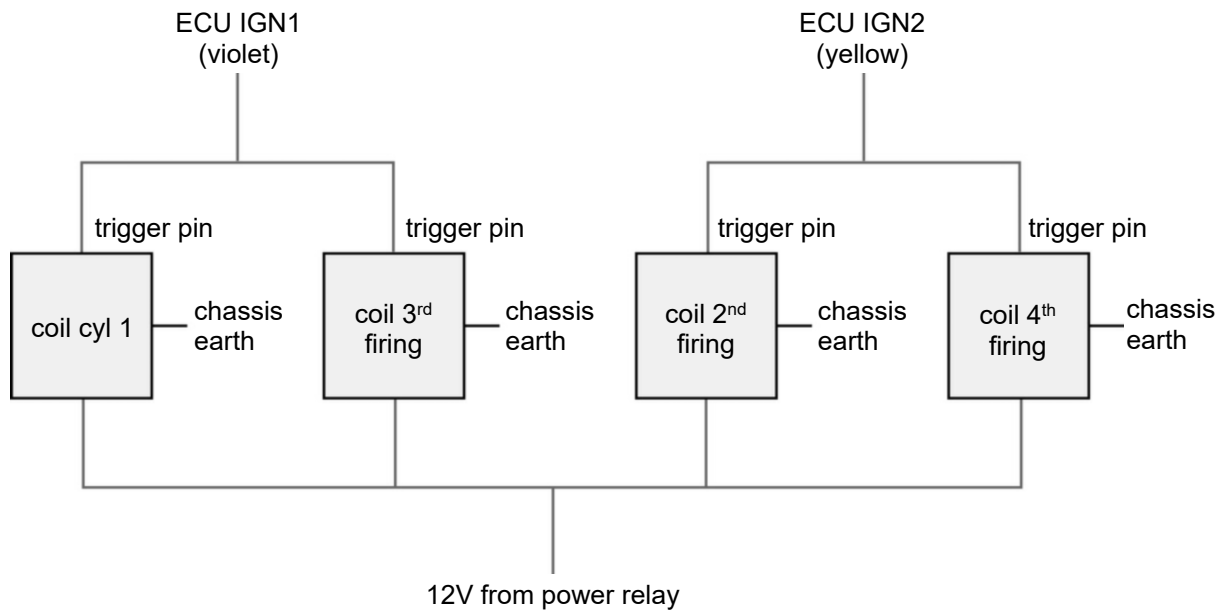
|                                                                                     |                                           |   |             |        |
|-------------------------------------------------------------------------------------|-------------------------------------------|---|-------------|--------|
|   | Ford Type A (early oval connector)        | 1 | ECU IGN1    | Violet |
|                                                                                     |                                           | 2 | +12V supply |        |
|                                                                                     |                                           | 3 | ECU IGN2    | Yellow |
|  | Ford Type B (later rectangular connector) | 1 | ECU IGN2    | Yellow |
|                                                                                     |                                           | 2 | +12V supply |        |
|                                                                                     |                                           | 3 | ECU IGN1    | Violet |
|  | Sagem / Valio (3pin connector)            | 1 | ECU IGN1    | Violet |
|                                                                                     |                                           | 2 | ECU IGN2    | Yellow |
|                                                                                     |                                           | 3 | +12V supply |        |
|  | Sagem / Valio (4pin connector)            | 1 | ECU IGN1    | Violet |
|                                                                                     |                                           | 2 | ECU IGN2    | Yellow |
|                                                                                     |                                           | 3 | +12V supply |        |
|                                                                                     |                                           | 4 | Not used    |        |

Coil-per-plug

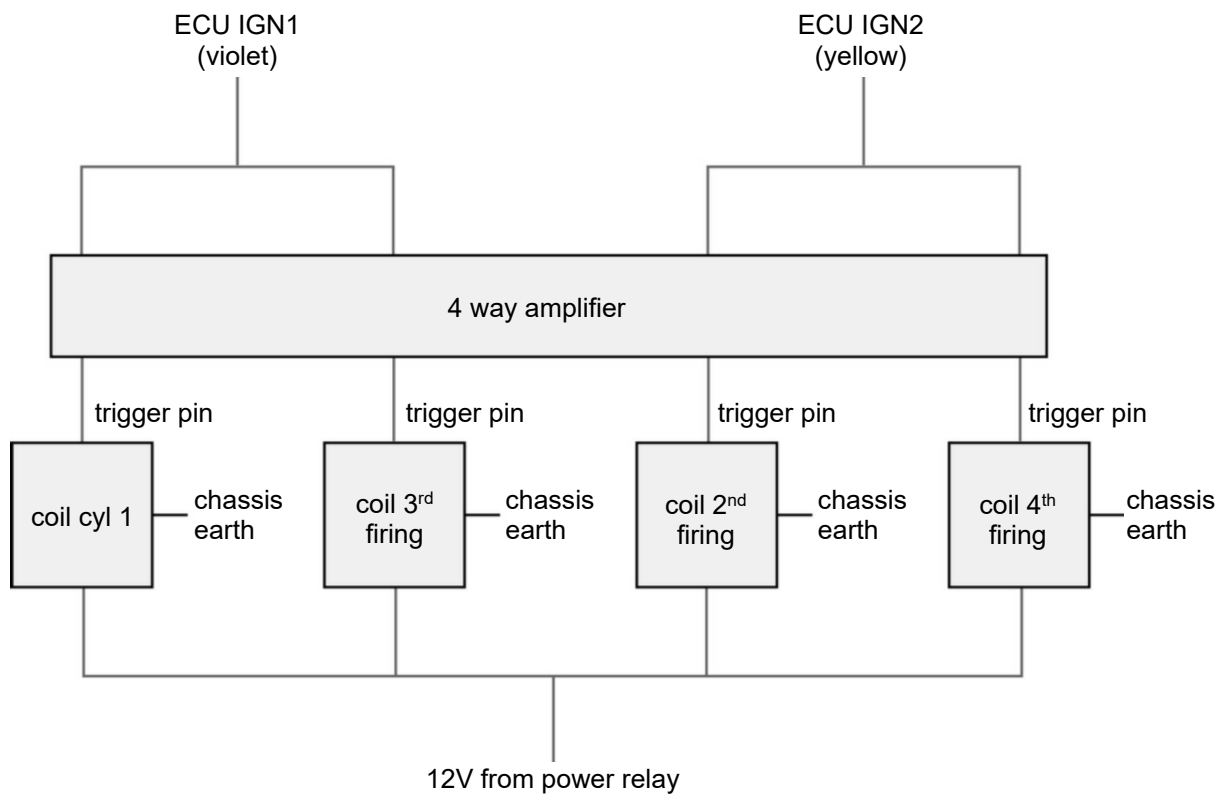
Coil-per-plug ignition coils can be controlled but only with wasted-spark ignition and will require amplification and the ECU hardware modified.



### Amplified coil-per-plug

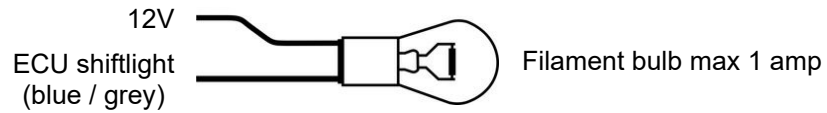
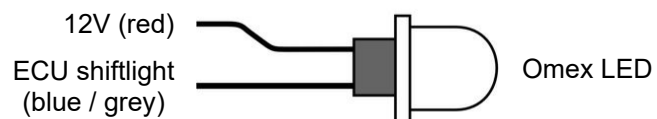
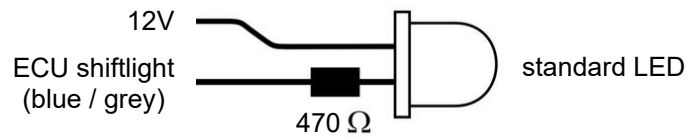
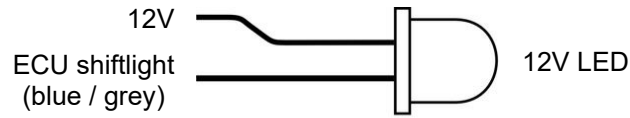


### Coil-per-plug with external amps



## 2.7 Shift Light

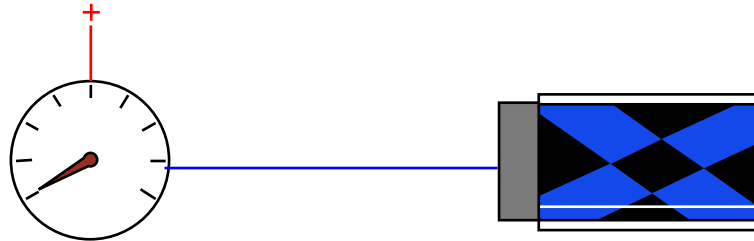
The shift light can be either an LED or a filament bulb of up to 1A current draw. If an LED is used it will need to be a 12V specific LED or must have an inline resistor fitted. An LED will glow slightly all of the time then turn on bright at the shift point. Omex can supply shift light LEDs that are fully off normally. If a filament bulb is used it will be fully off then fully on at the shift point.



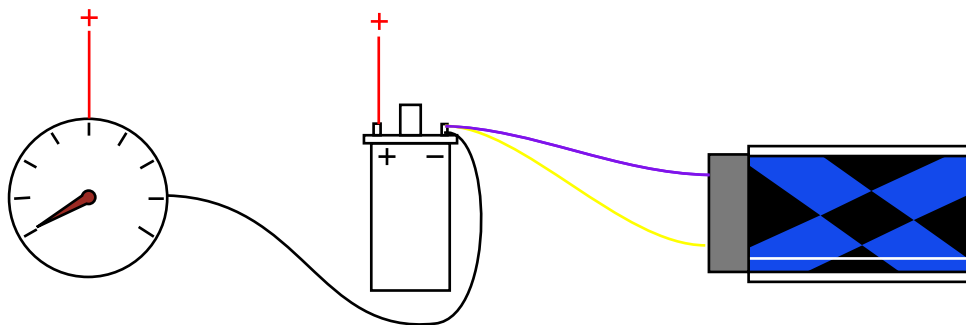
## 2.8 Tachometer

There are many types of tachometer, and how they are wired with the ECU depends on their type.

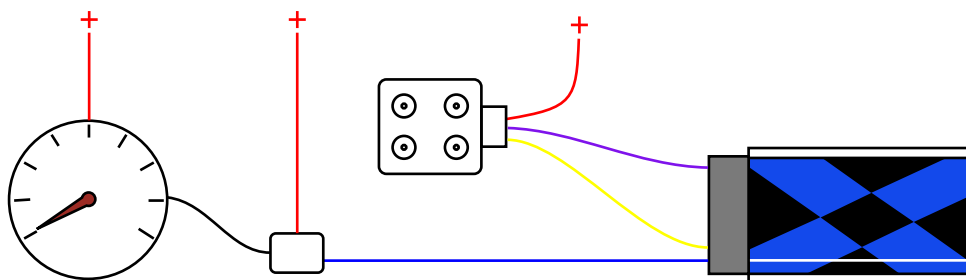
1. OE Tachometer, Originally ECU controlled  
Connect directly from the ECU TACHO output.



2. OE Tachometer, Originally coil negative controlled  
If still using a single coil and distributor ignition, leave the tacho wired as it originally was.

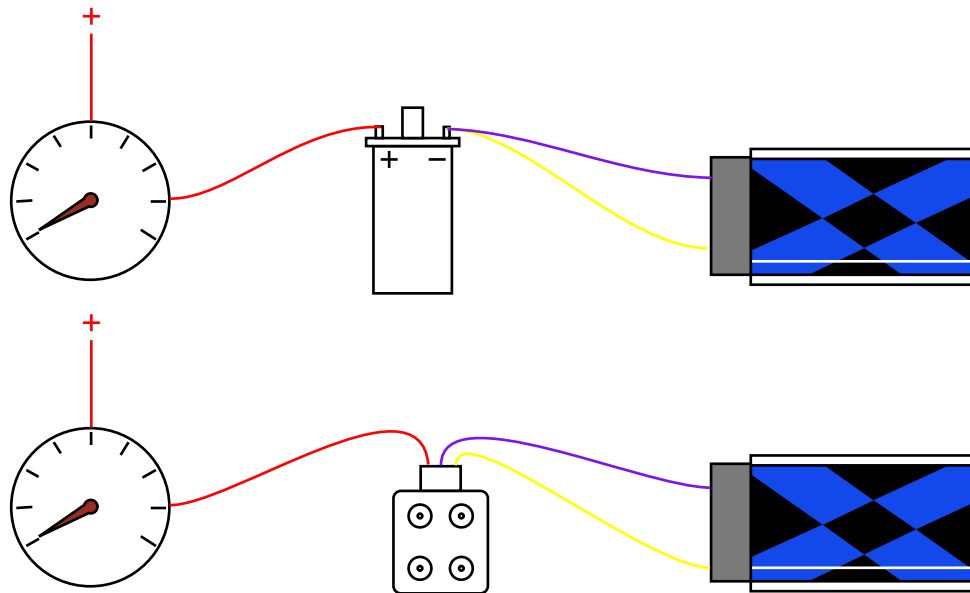


If the ignition system has been changed to a distributorless coil pack, the tacho needs to be controlled by the ECU TACHO output via a tacho driver available from Omex.



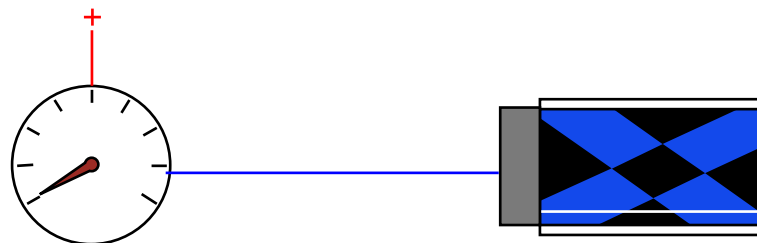
### 3. OE Tachometer, Originally coil positive controlled

The power supply to the ignition coil needs to be routed via the tachometer. This can work for either single-coil-and-distributor or distributorless-coil-pack ignition. If coil charge overlaps at high speeds on distributorless coils, then the tacho drops to 0rpm.



### 4. Aftermarket Tachometer

Most aftermarket parts can have the number of cylinders and the input type selected. The ECU's TACHO output is 0-batteryV, 50% duty cycle, 2 pulses per crank revolution.



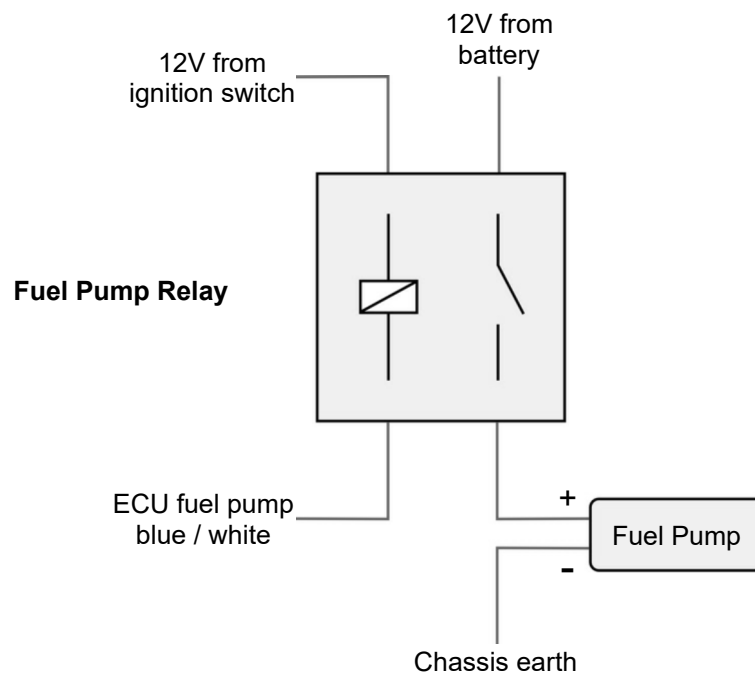


## 2.9 Fuel Pump

Although it is normal for the fuel pump to be physically ignition switched, for extra safety it can be ECU controlled.

When power is first given to the ECU it will turn on the fuel pump output for 2 seconds to prime the fuel system. When the ECU sees the engine cranking it will turn on the fuel pump output continuously. When the engine is stopped by turning off the ignition switch the fuel pump output will turn off immediately. If the engine stops in the event of a crash, the fuel pump output will turn off after 2 seconds.

The fuel pump is not controlled directly by the ECU, it must be controlled through a relay.



The power supply relay for the coil, can also be controlled by the fuel pump output. Though it is normal for this to be controlled just by the ignition switch.

## 3 Wiring

### 3.1 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;

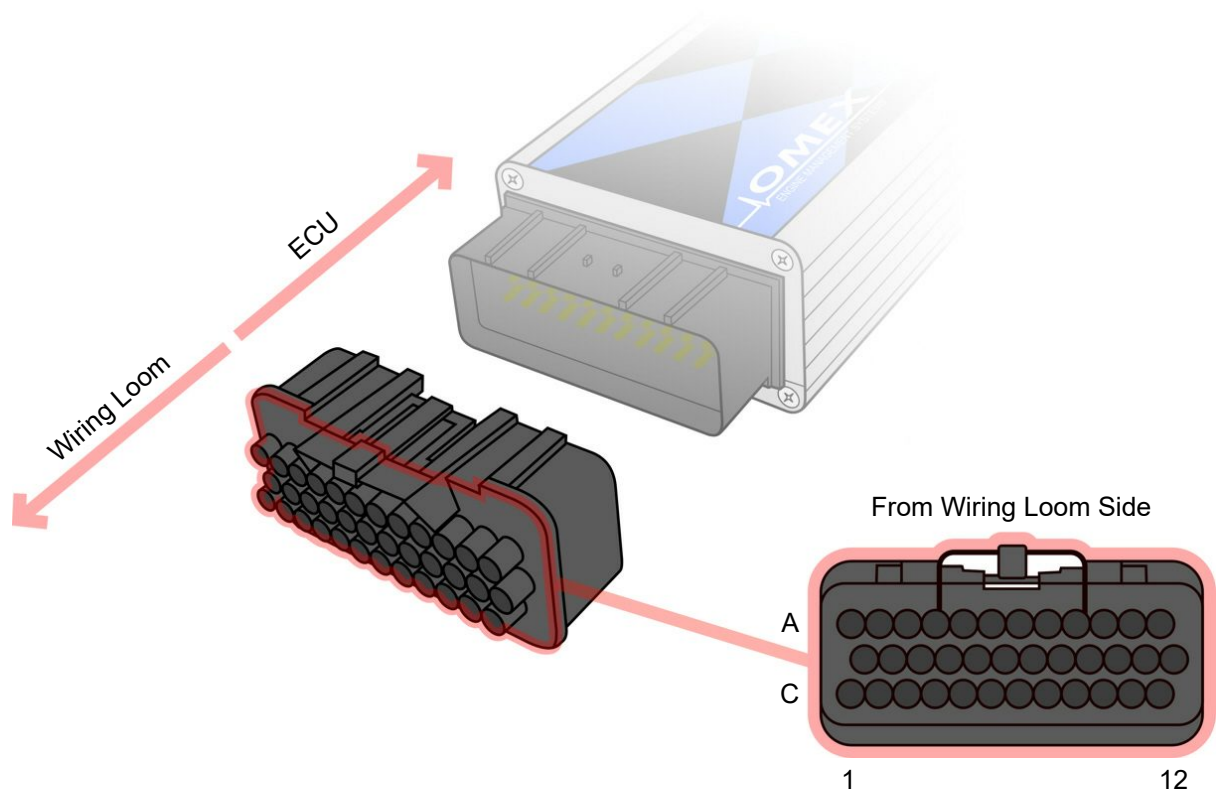
- The ECU should be mounted away from sources of extreme heat (such as exhaust), and away from direct water spray.
- If the loom is to go through panels, grommets should be used.
- The looming material holding the wires in the loom should totally cover the wires to prevent chaffing of the wire insulation.
- To minimize electrical interference, the sensors should be in a separately loomed section of the harness to the injectors and ignition coils.
- The connector terminals should be either crimped with the correct tool or crimped and soldered. Do not allow solder to go into the non-crimped section of the cable as this makes the cable brittle.
- Any joins should if possible be covered by a mechanically stiff material such as heatshrink.
- Care should be taken if using Raychem DR-25 heatshrink or glue lined heatshrink as the shrink temperature of these materials is high and it is possible to melt the cable insulation when shrinking these materials.
- The loom should be tied to mounting points using cable ties or p-clips to limit the additional stresses of the loom moving.

### 3.2 Ready Built Harness

Please see the notes supplied with the harness.

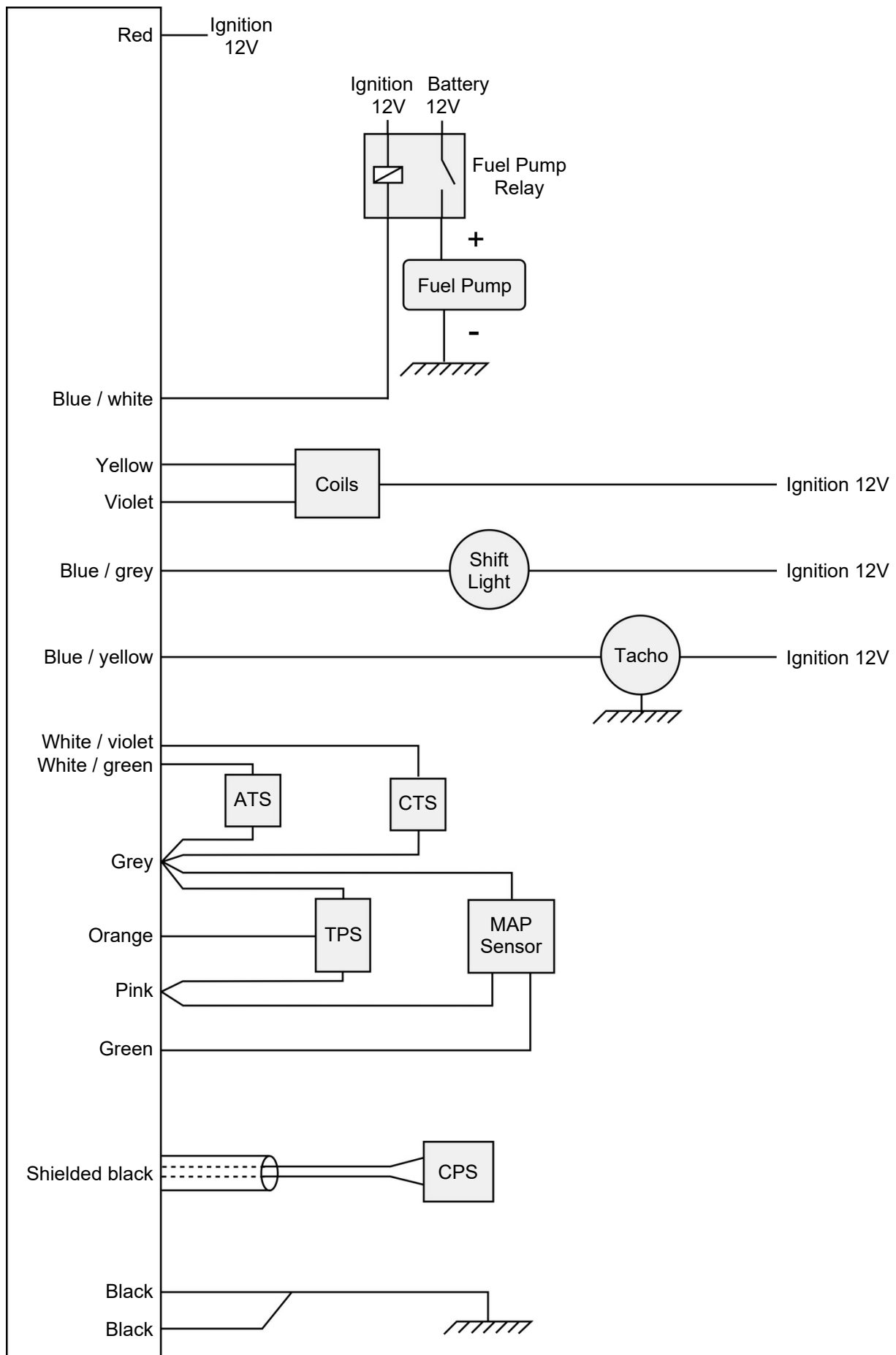
### 3.3 ECU Connector

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 on a cable, the main colour and the tracer colour can be either way round.



| number | colour code                                        | function                   |
|--------|----------------------------------------------------|----------------------------|
| 1A     | Violet                                             | Ignition 1                 |
| 2A     |                                                    |                            |
| 3A     |                                                    |                            |
| 4A     | Red                                                | Battery power              |
| 5A     | Black                                              | Chassis earth 1            |
| 6A     | Grey                                               | Sensor ground              |
| 7A     | Black screened red                                 | Crank sensor               |
| 8A     | Blue cables from the inside of the screened cables | Timing ground              |
| 9A     | White / violet                                     | Coolant temperature sensor |
| 10A    |                                                    |                            |
| 11A    |                                                    |                            |
| 12A    | Yellow                                             | Ignition 2                 |
| 1B     |                                                    |                            |
| 2B     |                                                    |                            |
| 3B     |                                                    |                            |
| 4B     |                                                    |                            |
| 5B     | Blue / white                                       | Fuel pump                  |
| 6B     | Green                                              | MAP sensor                 |
| 7B     | Black                                              | Chassis earth 2            |
| 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                      |

### 3.4 Typical Complete Wiring



## 4.0 ECU Dimensions

