

12/16/2012

Installation Instructions and Setup Guide | Jason Russell



## Table of Contents

<a href="#">Initial Information</a>	4
<a href="#">Legal Disclaimer</a>	4
<a href="#">Planning Guide</a>	4
<a href="#">Getting Started</a>	5
<a href="#">Power up on the bench</a>	5
<a href="#">Grounds</a>	5
<a href="#">    Power Grounds</a>	5
<a href="#">    Sensor Ground</a>	6
<a href="#">+12V Supply</a>	6
<a href="#">Connecting serial port</a>	7
<a href="#">Connect essential sensors</a>	8
<a href="#">    Crank Trigger</a>	8
<a href="#">    Connecting the primary trigger (Crank)</a>	8
<a href="#">    Configuring the crank trigger</a>	9
<a href="#">    Connecting the Secondary Trigger (Cam)</a>	9
<a href="#">    Configuring the Secondary Trigger (Cam)</a>	10
<a href="#">    Temperature Sensors</a>	10
<a href="#">        IAT – Inlet Air Temperature</a>	10
<a href="#">        CLT – Coolant Temperature</a>	10
<a href="#">        TPS – Throttle Position Sensor</a>	11
<a href="#">        Configuring the TPS sensor</a>	11
<a href="#">    Secondary Sensors</a>	12
<a href="#">        WBO2</a>	12
<a href="#">        EGT</a>	12
<a href="#">        Knock</a>	13
<a href="#">    Primary Outputs</a>	14
<a href="#">        Connecting Ignition Components</a>	14
<a href="#">        Example coil connections</a>	16

<a href="#"><u>Single coil</u></a> .....	<a href="#"><u>16</u></a>
<a href="#"><u>Coil pack</u></a> .....	<a href="#"><u>17</u></a>
<a href="#"><u>Coil on plug (COP)</u></a> .....	<a href="#"><u>18</u></a>
<a href="#"><u>Using the Stepper Motor Driver to control Ignition</u></a> .....	<a href="#"><u>18</u></a>
<a href="#"><u>Ignition Setup</u></a> .....	<a href="#"><u>19</u></a>
<a href="#"><u>Index engine</u></a> .....	<a href="#"><u>20</u></a>
<a href="#"><u>Injector Model</u></a> .....	<a href="#"><u>21</u></a>
<a href="#"><u>Injector Outputs</u></a> .....	<a href="#"><u>22</u></a>
<a href="#"><u>Secondary Outputs</u></a> .....	<a href="#"><u>22</u></a>
<a href="#"><u>Inputs</u></a> .....	<a href="#"><u>23</u></a>
<a href="#"><u>Misc Outputs</u></a> .....	<a href="#"><u>23</u></a>
<a href="#"><u>List of Authorized Resellers</u></a> .....	<a href="#"><u>24</u></a>
<a href="#"><u>Appendix</u></a> .....	<a href="#"><u>25</u></a>
<a href="#"><u>Connector pinout</u></a> .....	<a href="#"><u>25</u></a>

## Initial Information

### Legal Disclaimer

The authors, advisors, manufacturers, website maintainers or anyone involved in shipping or support are NOT responsible for consequences - even if it's proven that any injury, damage or inconvenience is directly caused by their advice.

No applicability of the hardware, firmware, other software, instructions, or documentation for a particular purpose is claimed.

All installers, diy-ers, and users are responsible for testing, installing, programming and using their units.

You understand that modifications are suitable to ruin your engine. Modifications usually invalidate any emission related certification, and most often invalidates the license to use the equipment (eg. car, snowmobile) at all. For off-road use only.

You understand that like any electronic or mechanical equipment, they can fail. Failing equipment in a vehicle can be fatal.

You are responsible for compliance with the laws of your jurisdiction.

If any provision of these Terms and Conditions is found to be invalid by any court having competent jurisdiction, the invalidity of such provision shall not affect the validity of the remaining provisions of these Terms and Conditions, which shall remain in full force and effect. No waiver of any of these Terms and Conditions shall be deemed a further or continuing waiver of such term or condition or any other term or condition.

In short, we can not cover every conceivable scenario. Please be aware of the consequences and plan accordingly. Be safe!

### Planning Guide

Things you need to know before ordering an ECU:

- Crank trigger type
- Trigger wheel
- Cam trigger type (if applicable)
- Number of Cylinders
- Number of coils
- Type of coil (logic level or high current)
- Number of fuel injectors
- Type of fuel injectors (high impedance or low impedance)

- Type and value of temperature sensors
- Any accessories or options you may want
- MAP sensor range (2.5 bar, 3bar, 4bar, or external)

Order info, options, ignition outputs, EGT, Knock,

## Getting Started

### Initial Power up

Connect all the grounds

### Grounds

From the outset it cannot be stressed enough just how important grounding is. 95% of all noise issues are due to poor grounding.

Grounds need to be connected with a clean connection and thick wire, and near the ECU. There are two branches so the fluctuation of power signals do not interfere with the measured signals (most importantly: the trigger):

Power Ground handles the noisy and high currents generated by driving injectors, coils and solenoids.

Sensor Ground handles 0 to 5v signals from crank, throttle and temperature sensors. VR-trigger sensor at low RPM (cranking) is the most sensitive to noise.

The GROUND rules:

- connect Sensor GND (EC36 pin 26) and the 4 Power GNDs with short (preferably 10..15cm, max 20..30cm from EC36), strong (preferably 0.75mm<sup>2</sup> or stronger) wires.
  - Power Grounds & Sensor Grounds MUST terminate at the same point - Common Ground. Run the wires into a single ring crimp so that there is no chance of one ground coming free.
- Keep the Power Ground connection (EC36 pin26, 5,21,22,32) pins to the Common Ground point short max 0.1 .. 0.3m,
  - use strong wires. Preferably all 5 wires should be 0.75mm<sup>2</sup> or stronger. Some installations (particularly with no PWM-ing) could tolerate somewhat longer wires, but why risk it ? (ground problems are like ghosts, very hard to track down). The length of wire(s) from this common ground point to battery / chassis can be longer (and usually are long). Strong wires must be preferred (total 4mm<sup>2</sup>), and not longer than necessary. But at least nowhere near as sensitive as the wires right at the ECU.
  - connect the ground of the sensors to the Common Ground point or to the sensor ground branch, that is EC36pin26.
  - Connect Power Grounds to the Common Ground point, or anywhere you like (except the sensor-ground branch)
- Failure to connect Sensor Ground and Power Ground will damage your VEMS. Even on the test bench !

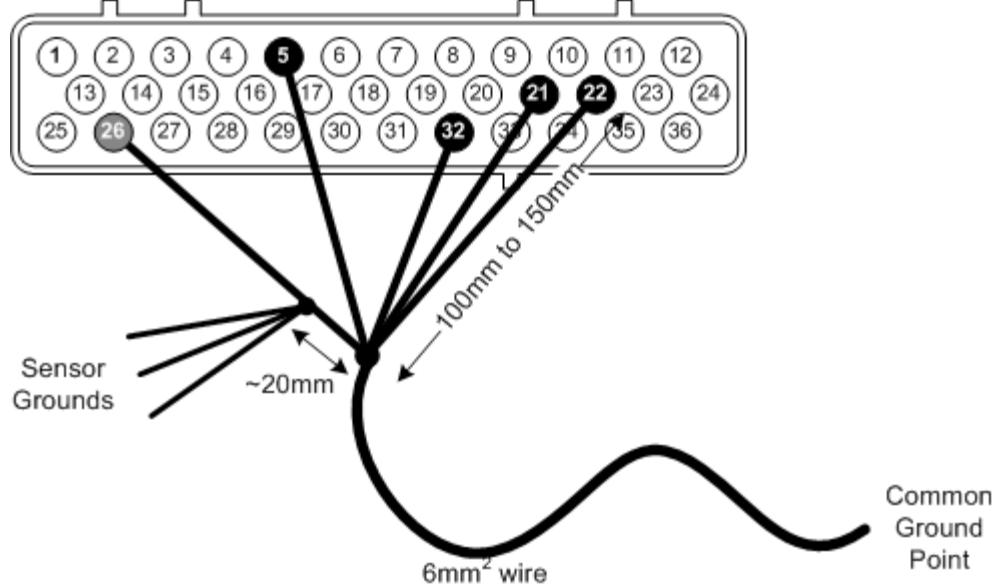
## Power Grounds

Also called as "GND5" in some documents

- EC36-pin5 to Common Ground
- EC36-pin21 to Common Ground
- EC36-pin32 to Common Ground
- EC36-pin22 to Common Ground

## Sensor Ground

- EC36-pin26 to Common Ground. NOTE: Sensor Ground pin has many connections (CAS, TPS, IAT, CLT ...) make provision for this in your wiring loom.

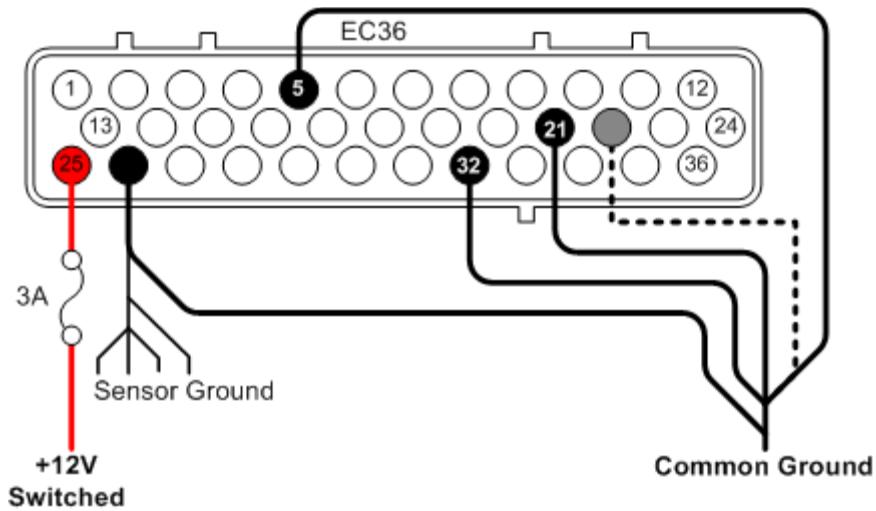


## +12V Supply

- EC36-pin25 3A Fused +12v supply

Note that if you have moved the battery to the rear of the car you may want to run separate wires for the starter/alternator and for the cars electrical system to the battery. Otherwise the several meters long cable will cause a significant voltage drop during cranking that will cause the ECU to reset when the battery starts to run low. This may prevent the car from starting even if the engine cranks over.

Once you have connected and checked the continuity of ground you can connect your VEMS unit to the EC36 plug and apply the power supply. There is little point in connecting power until the serial connector is added though.

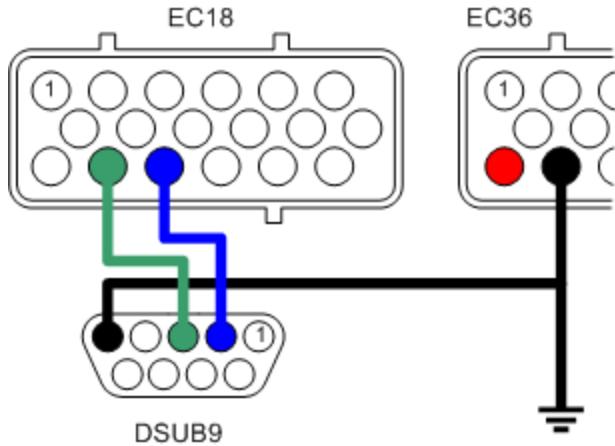


Connect the serial port

### Connecting serial port

To allow the connection of the VEMS unit to your PC a serial port plug must be connected as follows.

- EC18-pin14 to DSUB9-pin3
- EC18-pin15 to DSUB9-pin2
- EC36-pin26 to DSUB9-pin5 (GND).



### Start VemsTune and test connectivity

If you don't already have VemsTune, you can download it from here: <http://www.vems.hu/vt>

Always stay up to date with VemsTune. This is especially important when updating the firmware on the ECU. Older VemsTune releases may not understand and properly handle the newer firmwares.

Start VemsTune, select the COM port that is connected to the ECU. You may notice that a TCP connection is also supported if you have a TCP serial adapter.

## Connect essential sensors

### Crank Trigger

The trigger is the engine management system's most fundamental sensor, without one VEMS cannot calculate engine speed or crank angle. If you are connecting VEMS to an engine that has an existing engine management system, if not then a triggering method will need to be put in place.

The simplest type of trigger is to use the existing distributor to provide a pulse for each cylinder. This type of trigger is more than adequate for driving ignition through a distributor and batch fire injection.

### Connecting the primary trigger (Crank)

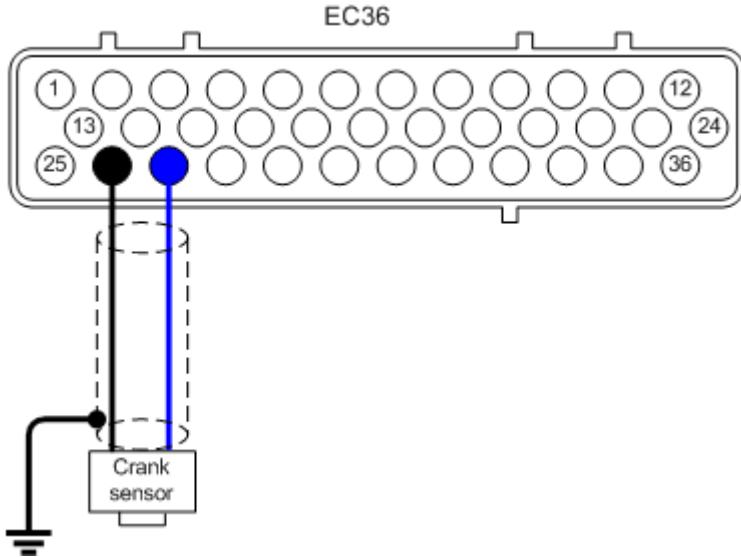
Magnetic sensor / Variable reluctance (VR)

Mechanical considerations

If you are fitting a crank sensor to an engine it is advisable to use a hall sensor rather than a VR sensor. They are more forgiving to wheel design and noise. Generally, VR sensors should be used in applications utilizing factory sensors.

The VR sensing circuitry is very sensitive to electrical noise, shielded cable (coax) must be used and good grounding is vital.

- EC36-pin27 VR+ Note that some other ECUs trigger on positive-going edge so their schematic might mark the + and GND swapped: so don't blindly follow naming from autodata pinout or some schematic, keep in mind that + and - might need to be swapped. Measure to be sure:  
[InputTrigger/TriggerLog](#)



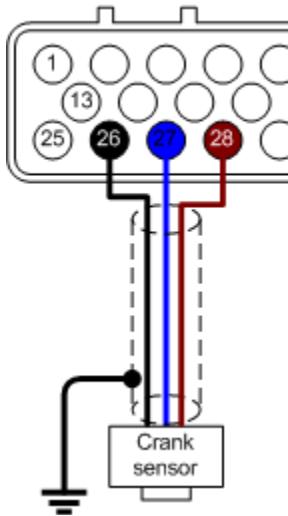
- EC36-pin26 VR-

Shielding should be grounded to engine block close to the VR Sensor.

Hall Sensor

VEMS is available configured for Hall sensors, these are more noise tolerant and require a +5V (or sometimes +12V for some sensors) supply.

- EC36-pin27 Hall signal
- EC36-pin26 Ground
- EC36-pin28 +5V



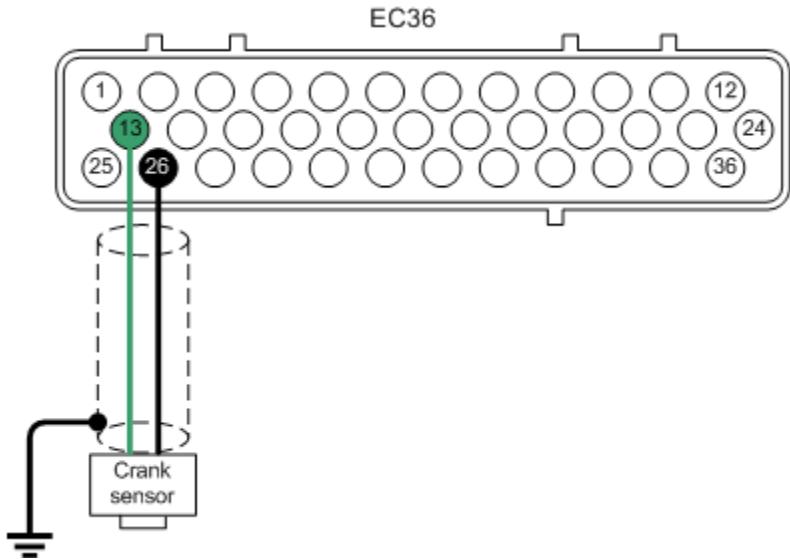
## Configuring the crank trigger

Crank Trigger configuration can be accessed from the Base Setup menu in the Primary Trigger Settings option. Trigger Edge should normally be rising for VR, falling for Hall. A hall sensor may be configured for rising if the trigger edge needs to be moved the width of a tooth, but this is generally not needed. Select the trigger type. Missing tooth is most common and includes 36-1, 60-2, and other common wheels with missing teeth. If the wheel doesn't have any missing teeth, that is coil-type. Missing tooth type should be n-1 if there is one missing tooth on the wheel, and n-2 if there are two missing teeth on the wheel.

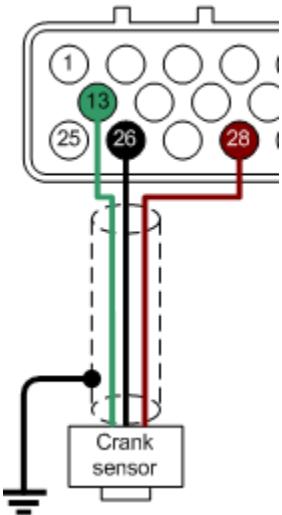
Number of teeth on the wheel is the number of remaining teeth. 58 for a 60-2 wheel for example. There are very useful defaults at the bottom of the window to set up your trigger wheel. TDC after the trigger needs to be measured and set with a timing light. Use the Tools → Ignition Lock menu item to set your timing at 0.25 degrees and crank the engine and verify cylinder 1 fires at TDC. Adjust the TDC after the trigger until correct. You may need to change the First Trigger Tooth if the TDC after the trigger value gets below 40 degrees or above 100 degrees. 60 degrees is a good value to aim for. Pressing F1 on the Primary Trigger Settings window, or any window in VemsTune, will give you some detailed help with more specific information.

## Connecting the Secondary Trigger (Cam)

VR type



Hall Effect Type



### Configuring the Secondary Trigger (Cam)

The secondary trigger is most often used for cam sync. This can be configured on the Base Setup menu under the Secondary Trigger Settings item. Mode is either Disabled or Cam-Sync except under special circumstances. Use rising edge for VR sensor. Either edge can be used for a Hall sensor, but typically falling is used. Event at Bad Trigger Position is the last common item to configure. It is recommended to set it to Just Show. You can have it disable injection if you wish, but it is not recommended.

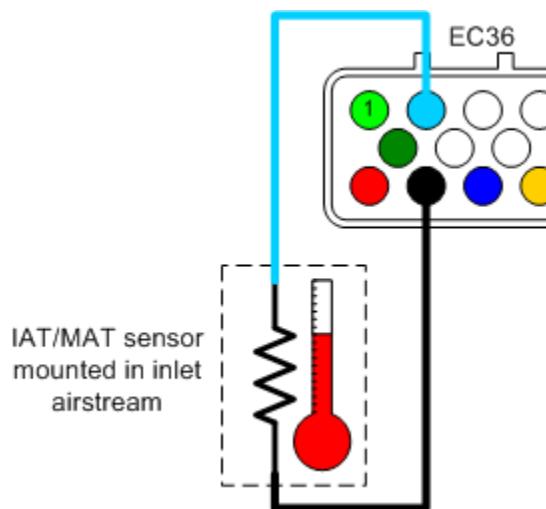
### Temperature Sensors

VEMS uses two temperature sensors: Inlet Air Temperature which is used in speed/density systems to calculate the amount of fuel required. And Coolant Temperature which is used to meter the required amount of warm-up fuel enrichment.

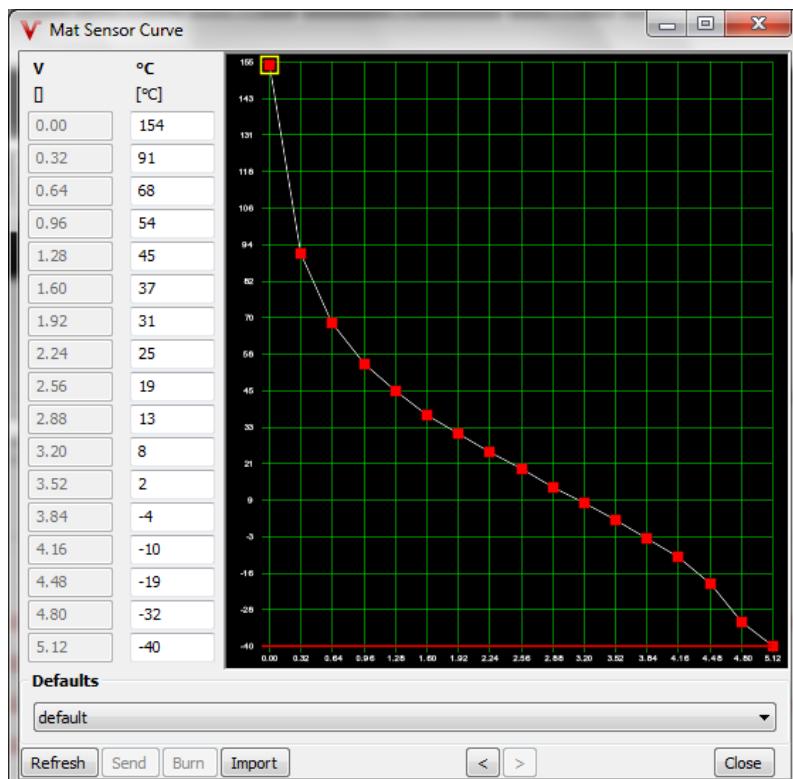
## MAT – Manifold Air Temperature

Also known as IAT, Inlet Air Temperature

- EC36-pin2 Signal
- EC36-pin26 Ground

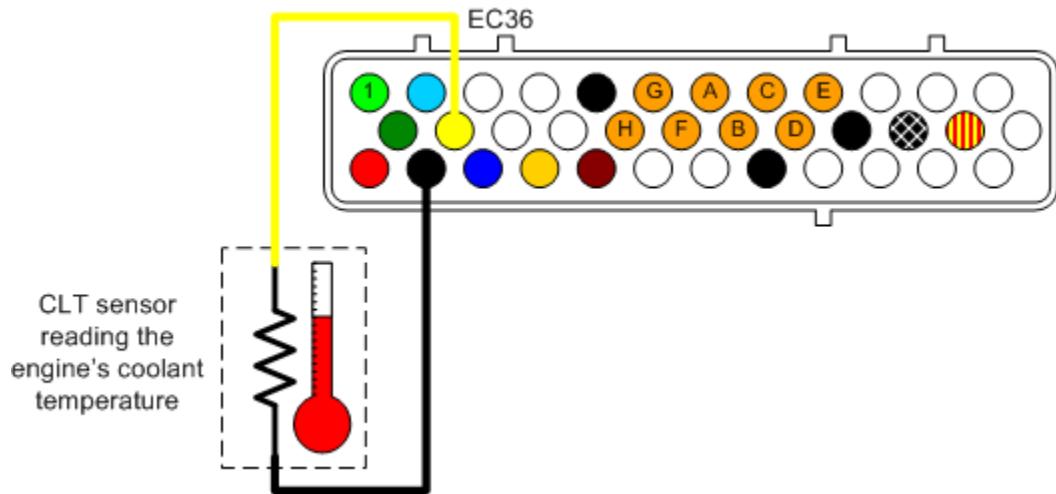


You can configure a custom sensor curve if needed under the Inputs menu with the MAT sensor curve item.

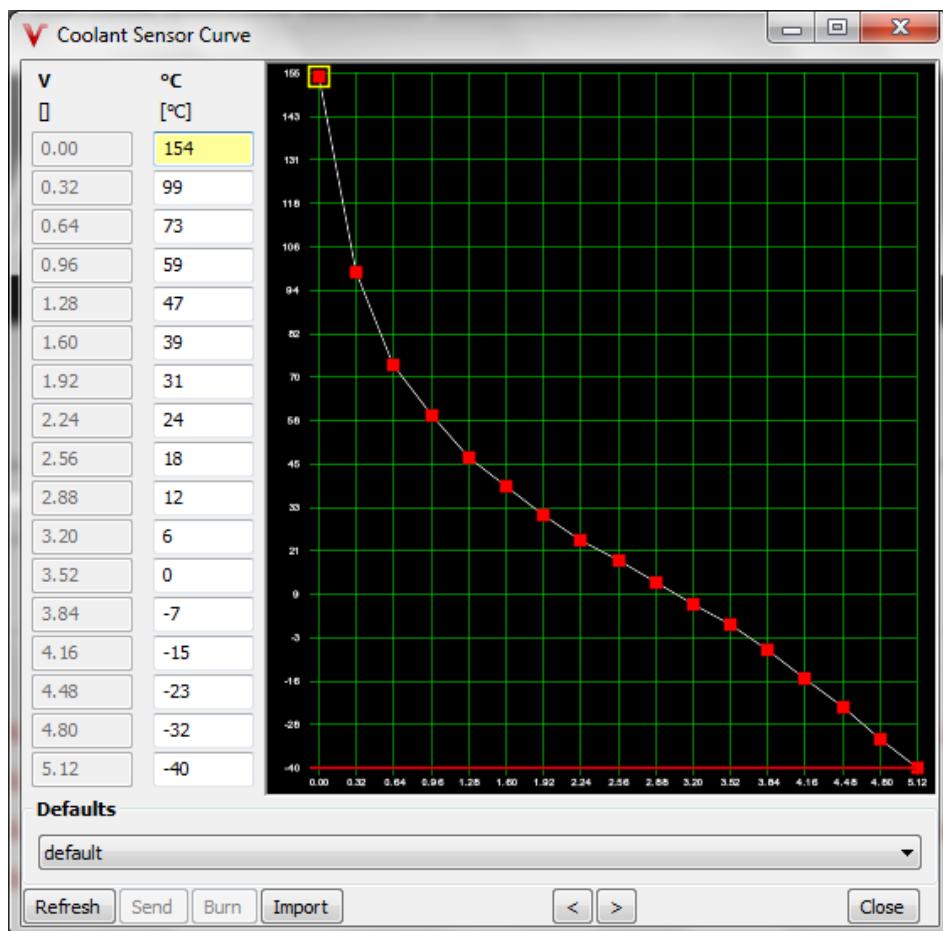


### CLT – Coolant Temperature

- EC36-pin14 Signal
- EC36-pin26 Ground



You can configure a custom sensor curve if needed under the Inputs menu with the Coolant Sensor Curve item.

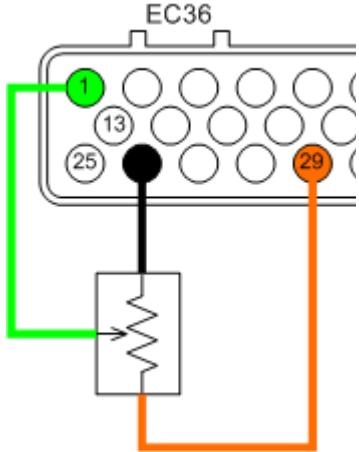


The standard Bosch CLT sensor curve is included in the Defaults section, and is close to many other sensors.

## TPS - Throttle Position Sensor

The throttle position sensor is used by VEMS to provide fuel requirements in Alpha-N configuration and acceleration enrichment.

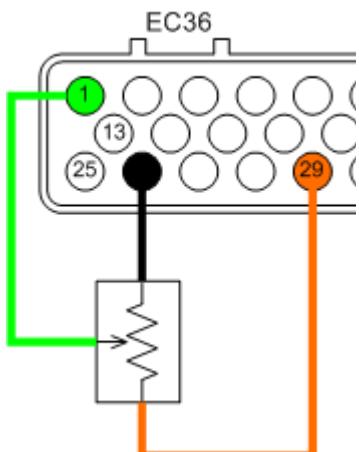
- EC36-pin29 TPS (+5v) out
- EC36-pin1 Wiper out (0-5v)
- EC36-pin26 Ground



## Configuring the TPS sensor

The throttle position sensor is used by VEMS to provide fuel requirements in Alpha-N configuration and acceleration enrichment.

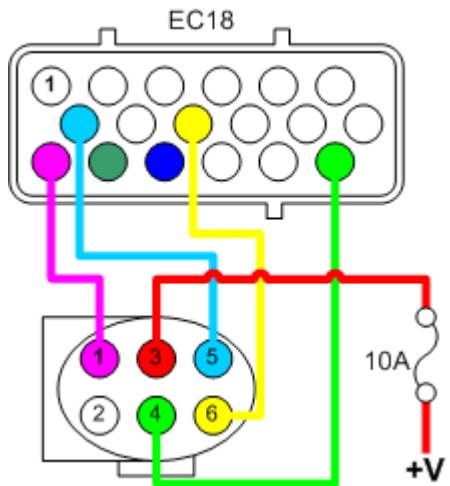
- EC36-pin29 TPS (+5v) out
- EC36-pin1 Wiper out (0-5v)
- EC36-pin26 Ground



## Secondary Sensors

### WBO2

- EC18-pin13 to WB6-pin1 (Nerst Cell Signal)
- EC18-pin7 to WB6-pin5 (WBO2 Pump-)
- EC18-pin18 to WB6-pin4 (WBO2 Heater)
- EC18-pin9 to WB6-pin6 (WBO2 Pump+)



### EGT

There are 2 standards that are the most common. You must make sure the + and - are connected properly. Everything is the same between the standards other than the colors. They are fully interchangeable.

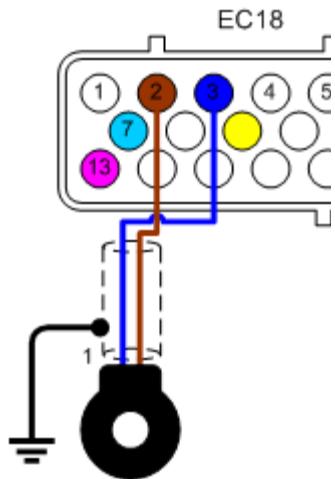
	British standard	American Standard
connector	green	yellow
wire insulation	green	yellow
+ wire	green	yellow
- wire	white	red



## **Knock**

Tuning the knock sensor is not a trivial task, and can take a considerable amount of time and experimentation to get right. Configuring the knock dynamics of an engine and over coming issues of mechanical noise can take a lot of time and effort, therefore you must not rely on the knock sensor to prevent knock, this can only be done by sensible tuning and using the correct octane fuel for your application.

Although VEMS will work with a variety of knock sensors the ones that have been tried and tested are Bosch, although other 2 or three wire sensors may work. Do not use a single wire knock sensor as they use the common ground of the block to create the circuit, using the block will inject too much noise into the sensitive knock circuitry.



- EC18-pin3 Knock sensor signal (Bosch type pin1)
- EC18-pin2 Knock sensor ground (Bosch type pin2)

Some Bosch type sensors are 3 wire type, pin3 is the cable's shield. On either type of sensor the shield should be grounded near or on the engine block.

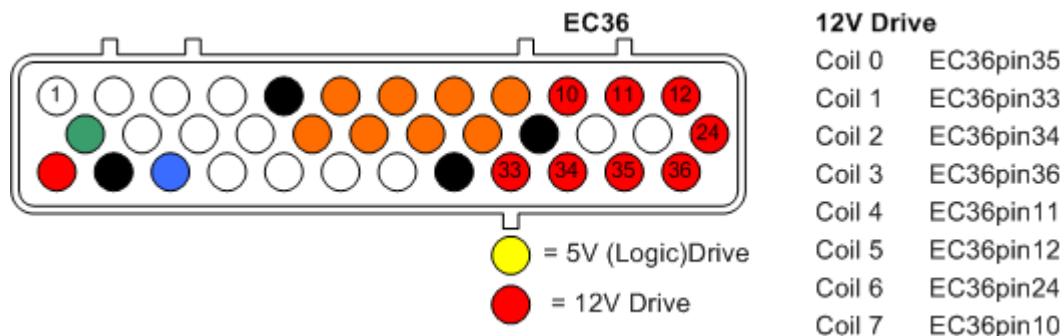
## Primary Outputs

NOTE: VEMS acts as a switch between the Component (injector, relay, ignition coil) and ground. VEMS does not provide the power to these components.

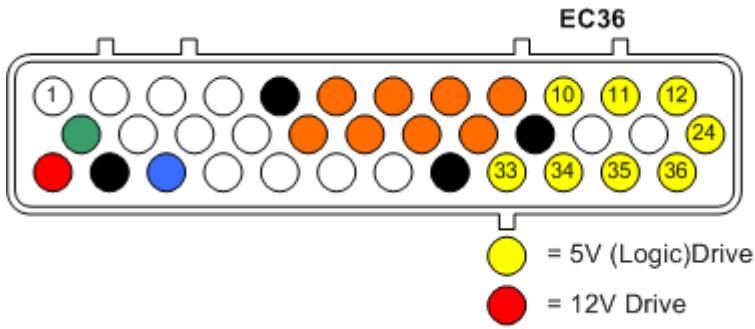
## Connecting Ignition Components

The unit can be ordered with one of five possible Ignition Channel Options.

Option 8 All 8 channels are high current control channels: (most common)

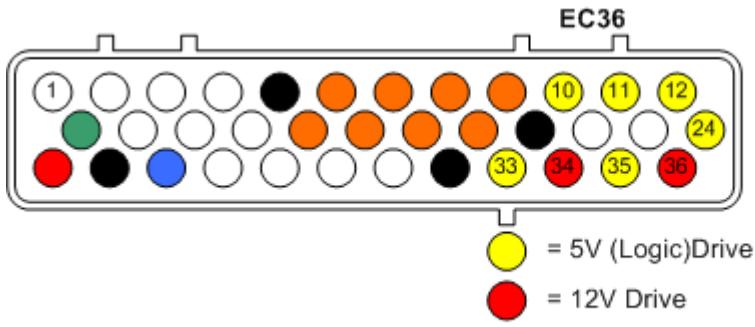


Option 0 All 8 ignition channels are using logic level(+5v) control for coils that have built in igniters or systems where you wish to use an existing igniter pack:

**5V (Logic) Drive**

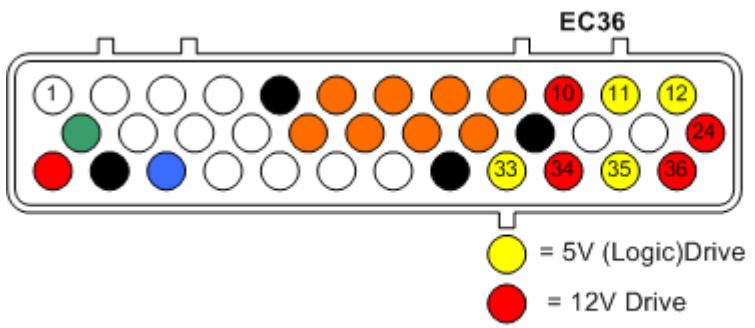
Coil 0	EC36pin35
Coil 1	EC36pin33
Coil 2	EC36pin34
Coil 3	EC36pin36
Coil 4	EC36pin11
Coil 5	EC36pin12
Coil 6	EC36pin24
Coil 7	EC36pin10

Option 2+6 Two channels are high current, the other 6 are logic level:

**12V Drive**

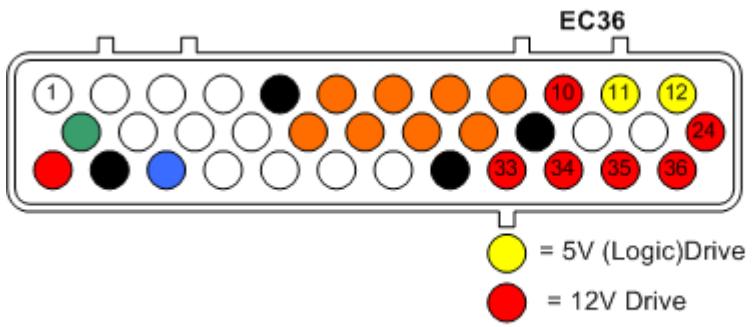
Coil 2	EC36pin34
Coil 3	EC36pin36
Coil 4	EC36pin11
Coil 5	EC36pin12
Coil 6	EC36pin24
Coil 7	EC36pin10

Option 4+4 Four high current channels, Four logic level:

**12V Drive**

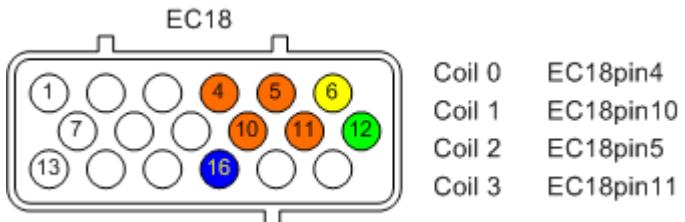
Coil 2	EC36pin34
Coil 3	EC36pin36
Coil 6	EC36pin24
Coil 7	EC36pin10
Coil 0	EC36pin35
Coil 1	EC36pin33
Coil 4	EC36pin11
Coil 5	EC36pin12

Option 6+2 Six high current channels, two logic level:

**12V Drive**

Coil 0	EC36pin35
Coil 1	EC36pin33
Coil 2	EC36pin34
Coil 3	EC36pin36
Coil 6	EC36pin24
Coil 7	EC36pin10
Coil 4	EC36pin11
Coil 5	EC36pin12

Alternative Connection If you are using an external ignition module/igniter pack you can also use the Stepper Motor outputs as control channels:



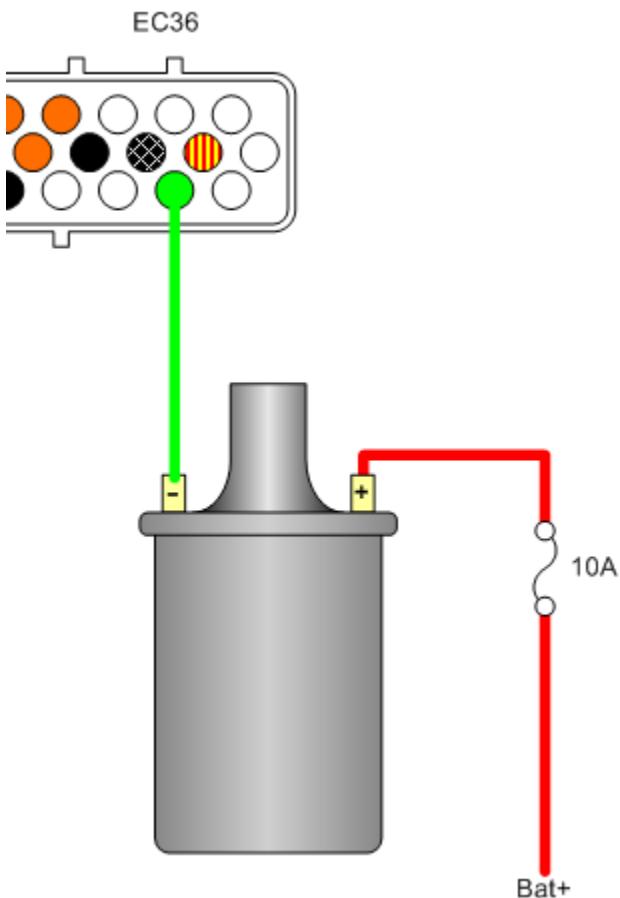
This method is suitable for 4 cylinder COP/CNP or 4, 6 and 8 cylinder wasted spark.

### Example coil connections

The following connections suggest the pin numbers as a suggestion only. The actual connections will depend on the Ignition Channel Options as above.

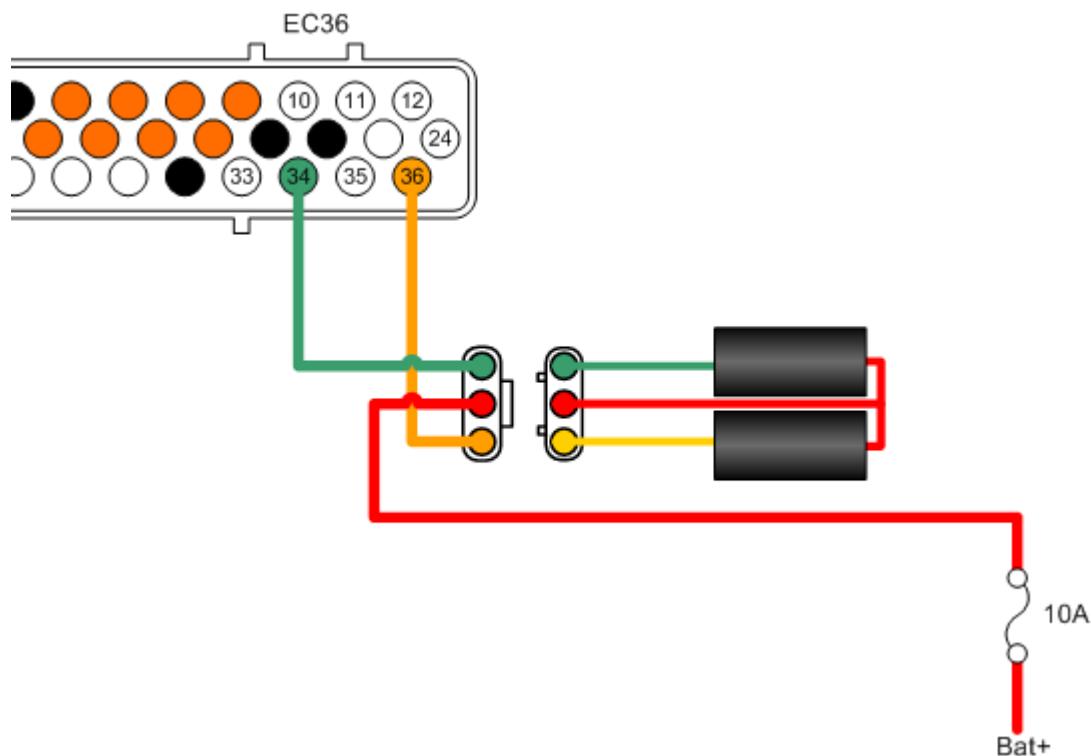
#### Single coil

In some instances you will want to keep the distributor, in this case VEMS can be configured to use the original coil as shown.

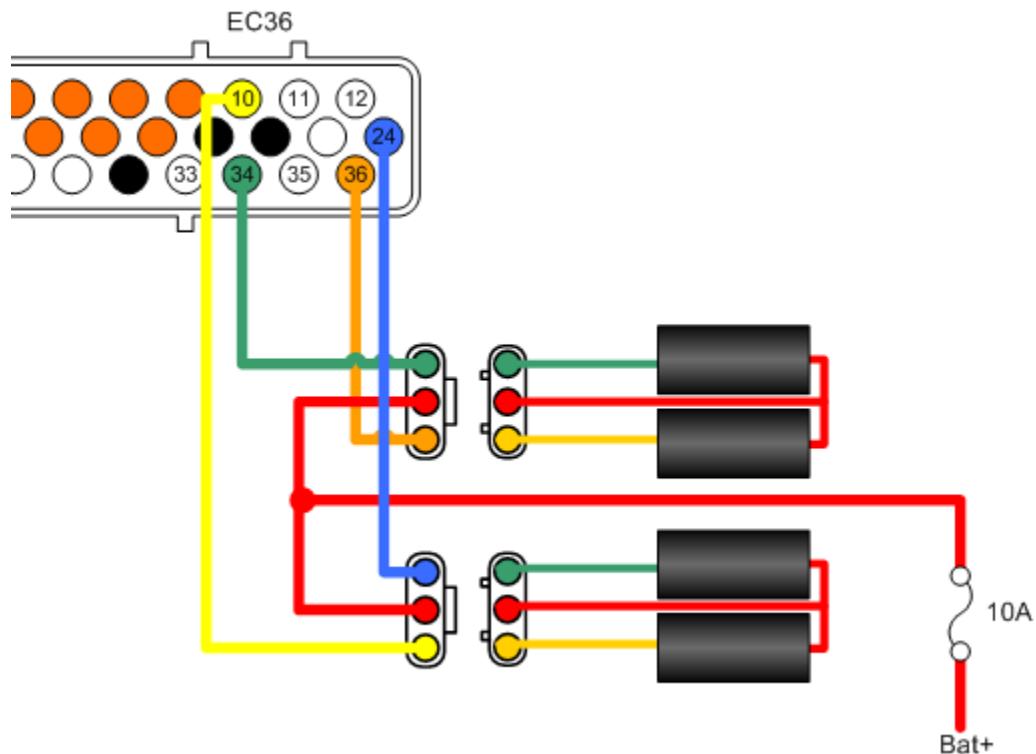


## Coil pack

Connecting a two coil (4 cylinder wasted spark)

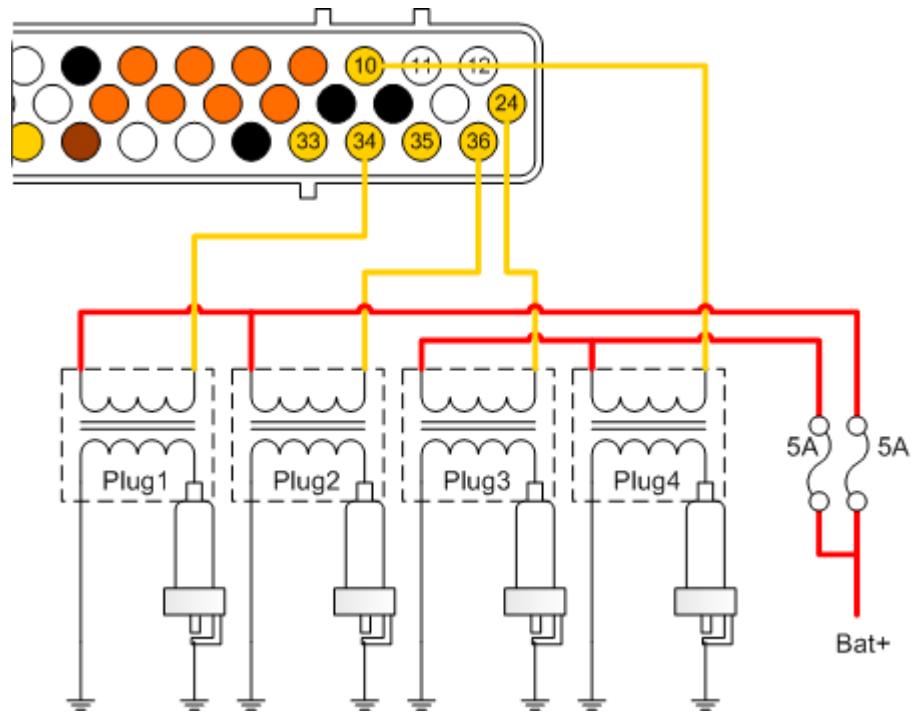


Additional coil packs, for applications such as 8 cylinder wasted spark

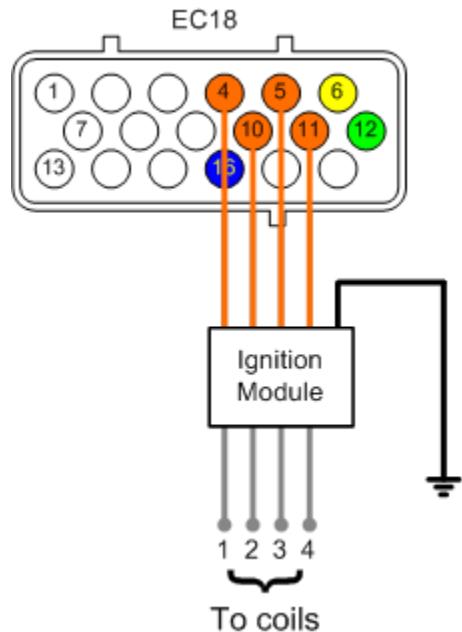


## Coil on plug (COP)

Individual Coil connections are shown, the pins connect to the negative '-' side of the coil.



## Using the Stepper Motor Driver to control Ignition



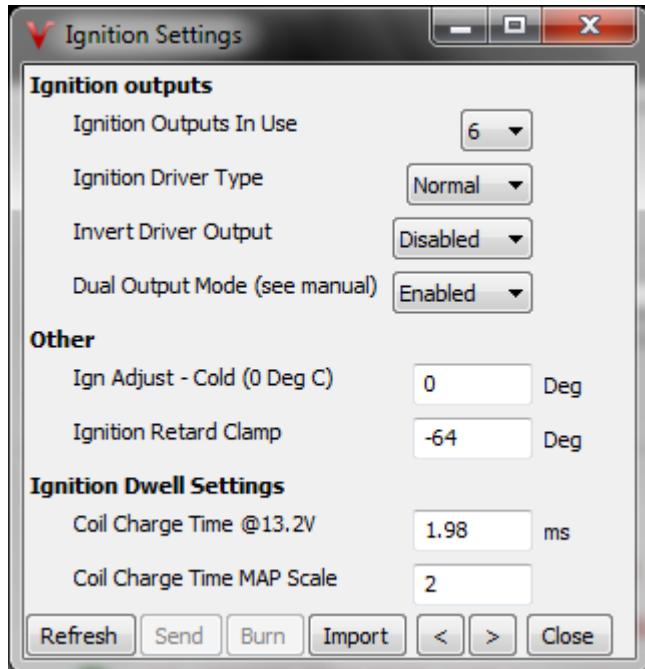
In some cases it has been found that we need to drive external ignition amplifiers (ignitors) using the higher current stepper motor driver.

If you have been using the EC36 plug, the wires must be swapped from the Ignition pins on the EC36 plug and moved to the EC18 plug as follow

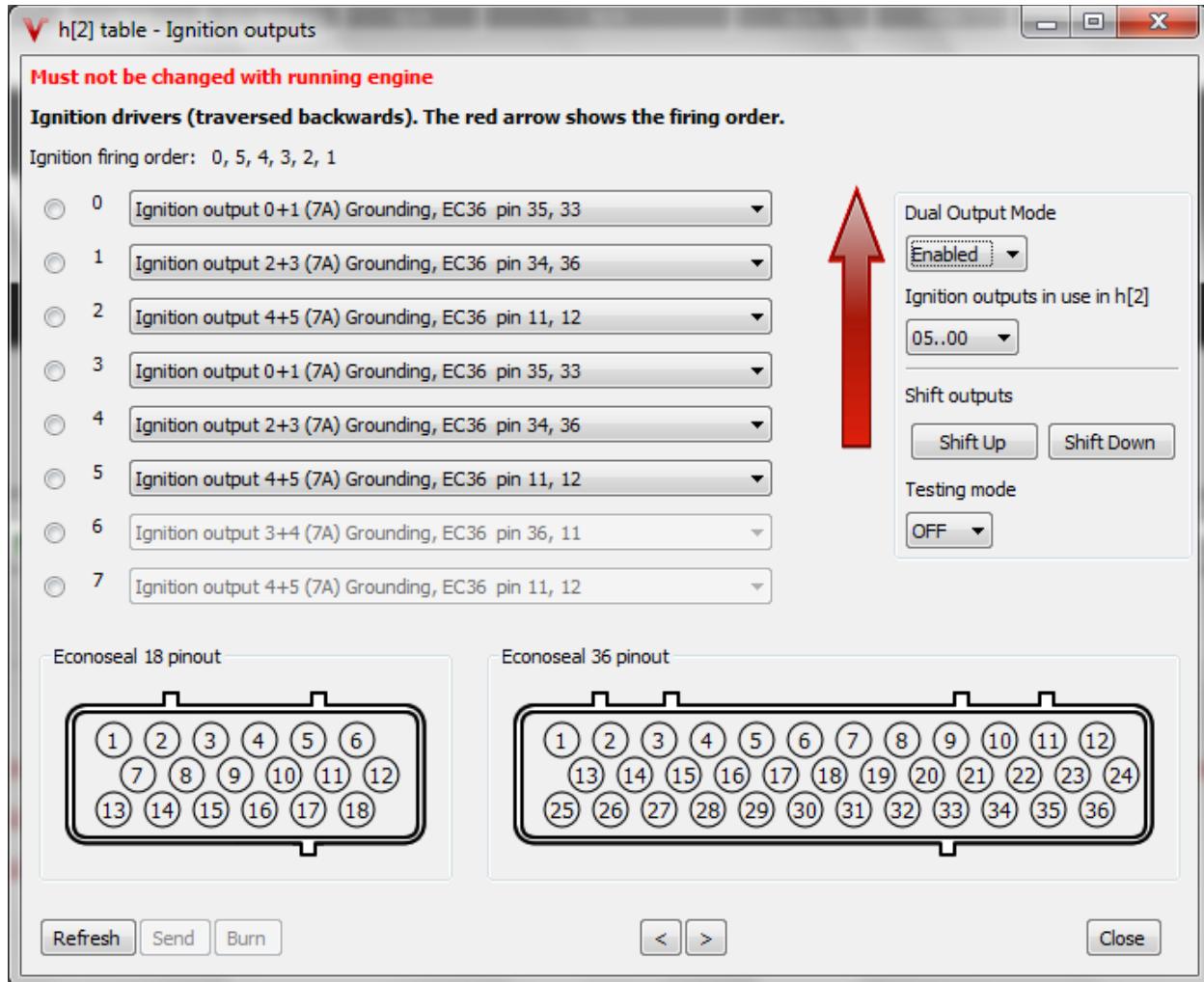
- Coil 00 EC36-pin35 to Stepper A EC18-pin4
- Coil 01 EC36-pin33 to Stepper B EC18-pin10
- Coil 02 EC36-pin34 to Stepper C EC18-pin5
- Coil 03 EC36-pin36 to Stepper D EC18-pin11

## Ignition Setup

Set the dwell and number of ignition channels used on the Base Setup → Ignition settings menu.



Set the firing order in the Base Setup → Ignition Outputs Visual menu. The firing order starts with index 0, wraps around the bottom and works it's way up. You can easily adjust this using the Shift Outputs: Shift Up and Shift Down buttons.



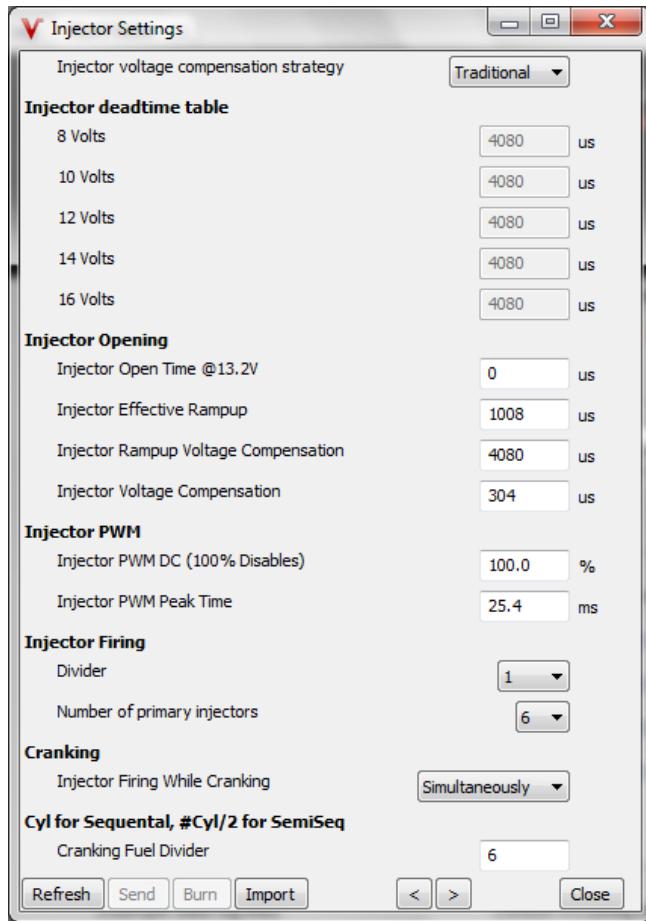
If you have a coil on plug or coil near plug coil setup, you can still run wastespark by enabling the Dual Output Mode. With this setting, each ignition entry will be two pins. You must make sure they are on opposing cylinders in the firing order.

## Index engine

Tools required: Timing light

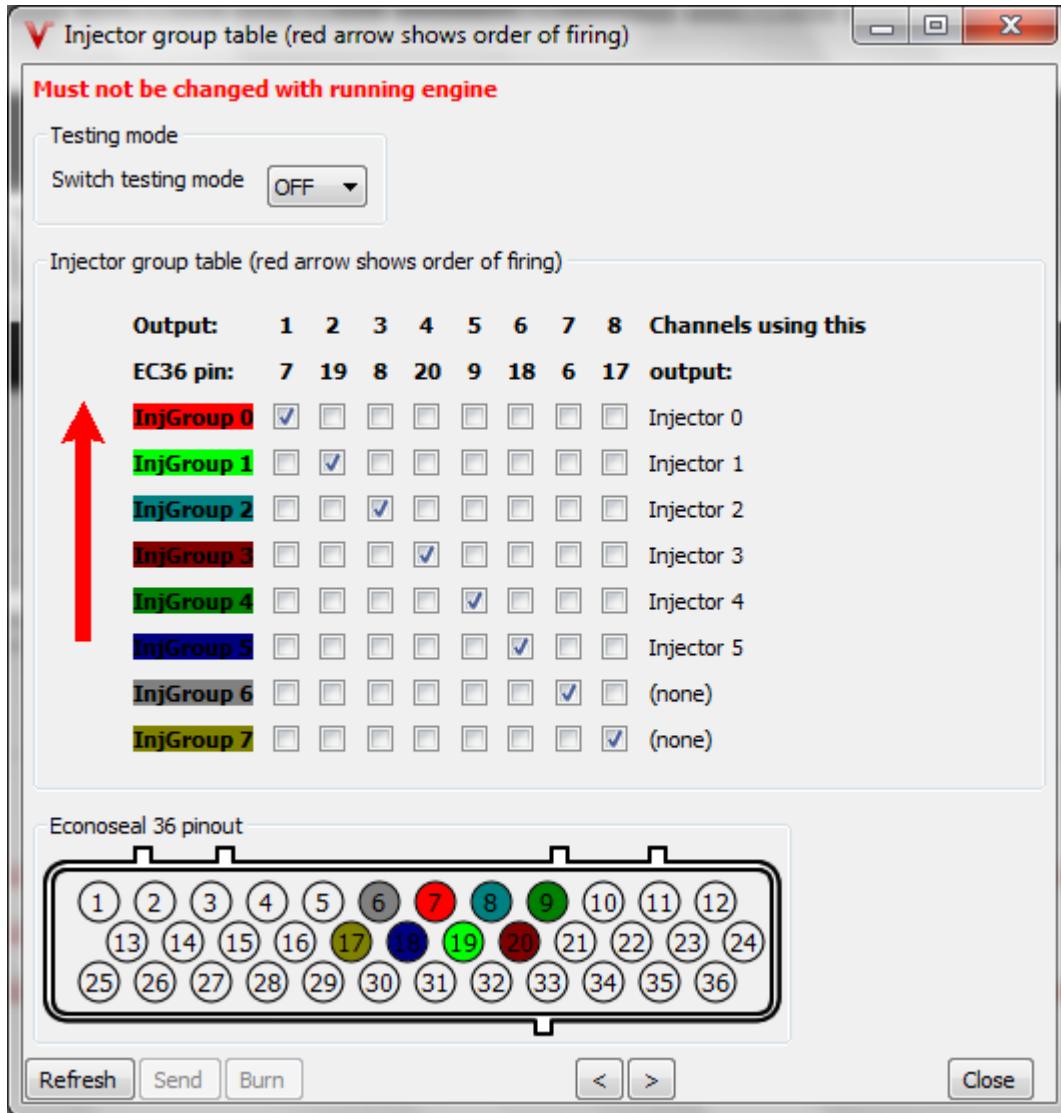
With injectors still disconnected, strobe the crank pulley with the timing light on each cylinder following the firing order to make sure each cylinder is firing where it should be. It is helpful to use a marker or paint pen to mark the pulley where each cylinder should fire with a different color. Then you can easily change cylinders and crank to make sure the cylinders are firing at the proper time.

## Injector Model



Choose the number of primary injectors, usually the number of cylinders. Divider is usually 1. For high impedance injectors, PWM DC should be 100% and Peak Time should be 25.4ms.

## Injector Outputs



Setting the injectors like this will work fine, it's not important which injector fires when except for emissions. You can set the injectors to firing order, but it is generally recommended to wire up the injectors to the cylinder firing order. For instance, Injector 1 goes to the first cylinder that fires. Injector two goes to the second cylinder that fires. It is recommended to return and fine tune the injector order after you have the engine running.

## Secondary Outputs

### Fuel Pump

Configured in the Outputs menu under the Fan / Water Pump / Fuel Pump item. Set the time to run the pump on power-up to prime the fuel system and also the time to shut off the pump after the engine looses the trigger (stalls for instance). Usually these are set to 1.5 to 2.0 seconds.

## Idle Air Controller

Setup is under the Starting/Idle menu in the Idle Control General item. There are 3 main types of supported idle controllers. A simple On/Off type where it just opens a valve to activate high idle, a PWM type where it has more granular control of the valve, and a stepper type that uses a stepper motor to adjust the idle valve opening. Select the type you have, select the target idle targets for cold and warm engine, and the temperature thresholds for each. The rest of the settings are explained well in the help menu (Press F1).

## Boost control solenoid

Wire up to a spare injector or ignition channel preferably. There are two types of boost control. Boost PID and Secondary PWM. Usually Boost PID control is used. Start by setting the output channel in Outputs, Assign Output Channels. Boost Target should be MAP Target for using the main MAP sensor for the boost sampling. Alternatively you can use a secondary pressure sensor and configure as Boost Target.

## Inputs

### Clutch switch

Used for WOT Shift Cut primarily. Select the Analog Input channel under the Inputs menu.

### Activation switches

Configured under the Inputs menu also. Used for Table switch, ALS, Launch control, N2O, and Warning.

### Wheelspeed VSS

Wheelspeed input is normally EC18 pin 8, for Hall sensor (5v square wave signal). An external converter can be used for other signals. Having this input allows gear based boost control, fuel consumption calculations, speed based launch control, etc.

## Misc Outputs

### Set up output channel

All output channels are configured under the Outputs menu, Assign Output Channels item.

### Tach

The standard output is Low Current Output 0 EC36 Pin 4, which has a pull-up resistor to 12V by default. This will give a 12V square wave for most modern tachometers. The default is to output one pulse per spark. The divider can be changed in the Outputs → Tach menu and details for the divider can be found in the help.

### Shift Light

Shift light function is configured using the RPM Actuator. Once the output is chosen the details can be set under the Outputs → RPM Actuators menu.

## List of Authorized Resellers

## Appendix

### Connector pinout

