EmeraldM3D K6

Engine Management System

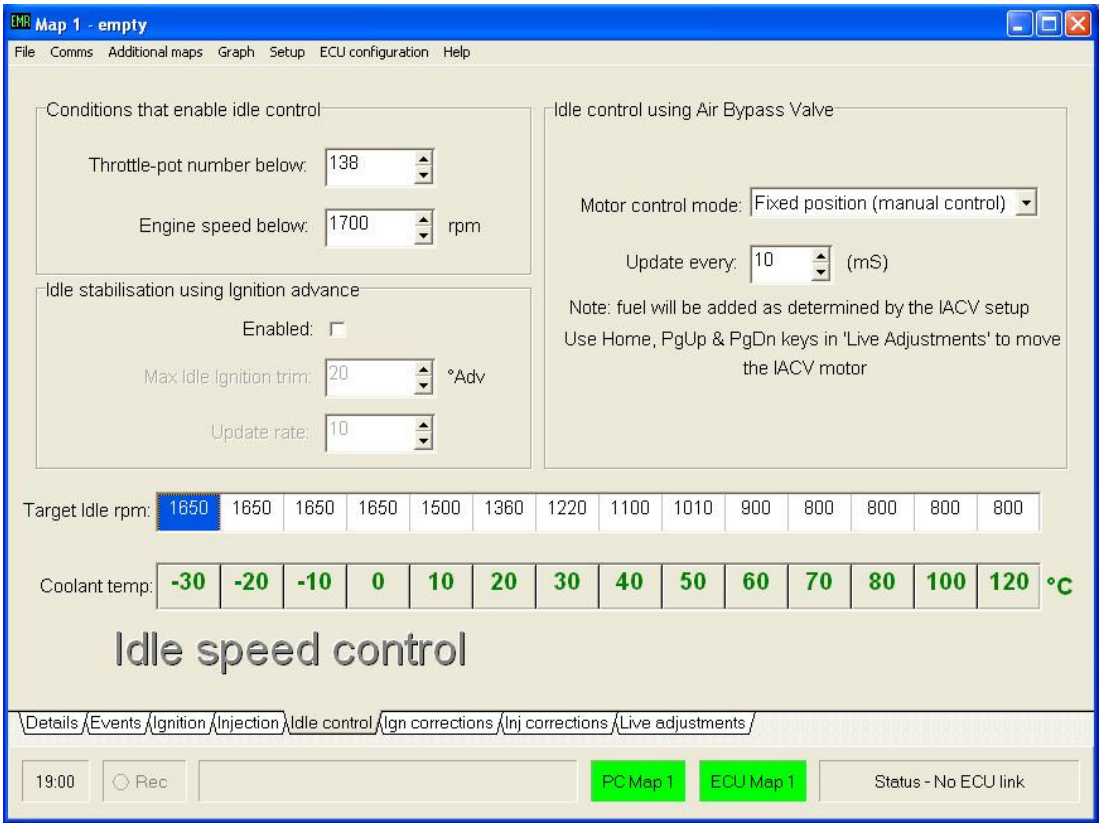
Idle Air Control Valve & Cold Start Calibration.

To suit engines using TPS as primary load reference.

V1.00

Idle Air Control Valve – IACV setup

Irrespective of the type of IACV valve your engine is fitted with its intended purpose will be to allow your engine to maintain a specified idle speed under a range of different conditions. To setup the IACV valve first go to the "Idle speed control" tab (F5) within the PC software and set it up so it looks like the example below.



Note that your "Throttle-pot number below" within the "Conditions that enable idle control" area of the screen will be unique to your installation so **do not** set it to match the above screen shot. After making the changes, re-program the map/ECU. Now select the "Live Adjustments" screen (F8) and start the engine.

Use the Home (fully close valve), PgUp (opens valve) and PgDn (closes valve) keys to set the IACV to a fully closed or near closed position. With the engine fully warm and idling adjust the throttle stop to obtain the desired engine idle speed then, if required, modify the numbers in the "Target idle rpm" 2D map to suit.

Use the – and + keys to either decrease or increase the amount of ignition advance at idle (the 0 key can be used to clear the ignition trim), so that the engine is idling with around 0 degrees of ignition at a speed slightly below the "Target idle rpm". Pressing "Enter" with a trim in place will save it to the map/ECU.

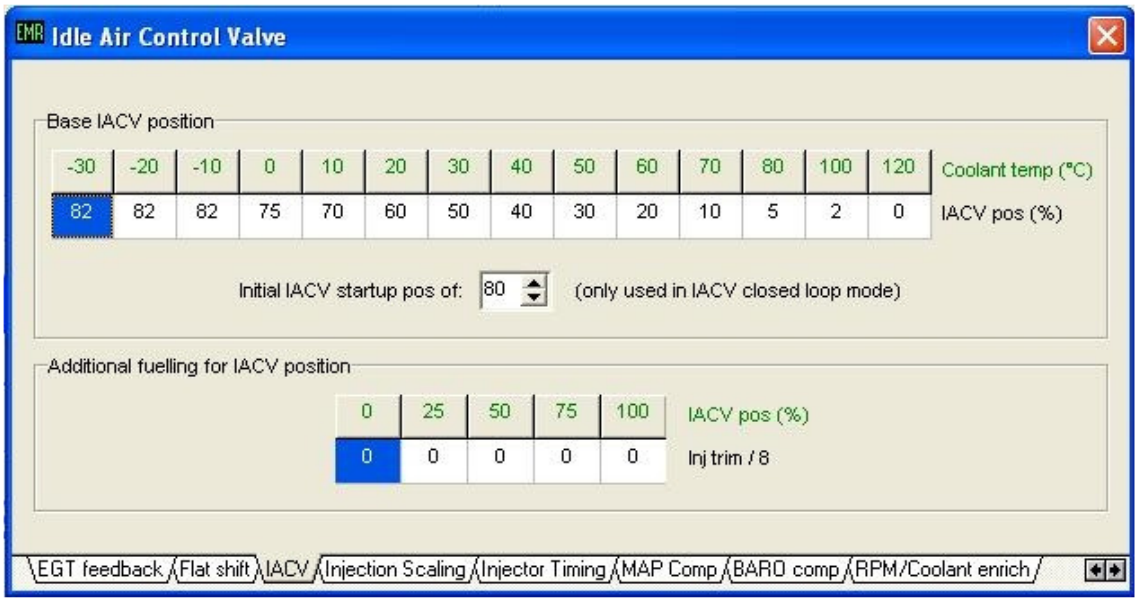
If required, also adjust the "Injection trim" accordingly (2 to decrease, 3 to increase, 0 to clear the trim, and "Enter" to save the trim to the map) to maintain a clean and smooth idle.

Once any necessary adjustments have been made to the throttle stop, realign the throttle position via the "Throttle Position Sensor" option found in the drop-down "Setup" menu. Follow the on screen instructions to do this.

Revisit the above adjustment loop if required and then proceed as follows.

Go to the “Additional maps” drop-down menu and select the “Idle Air Control” option. A pop up window will appear, as per the below example, that is split into 2 different maps.

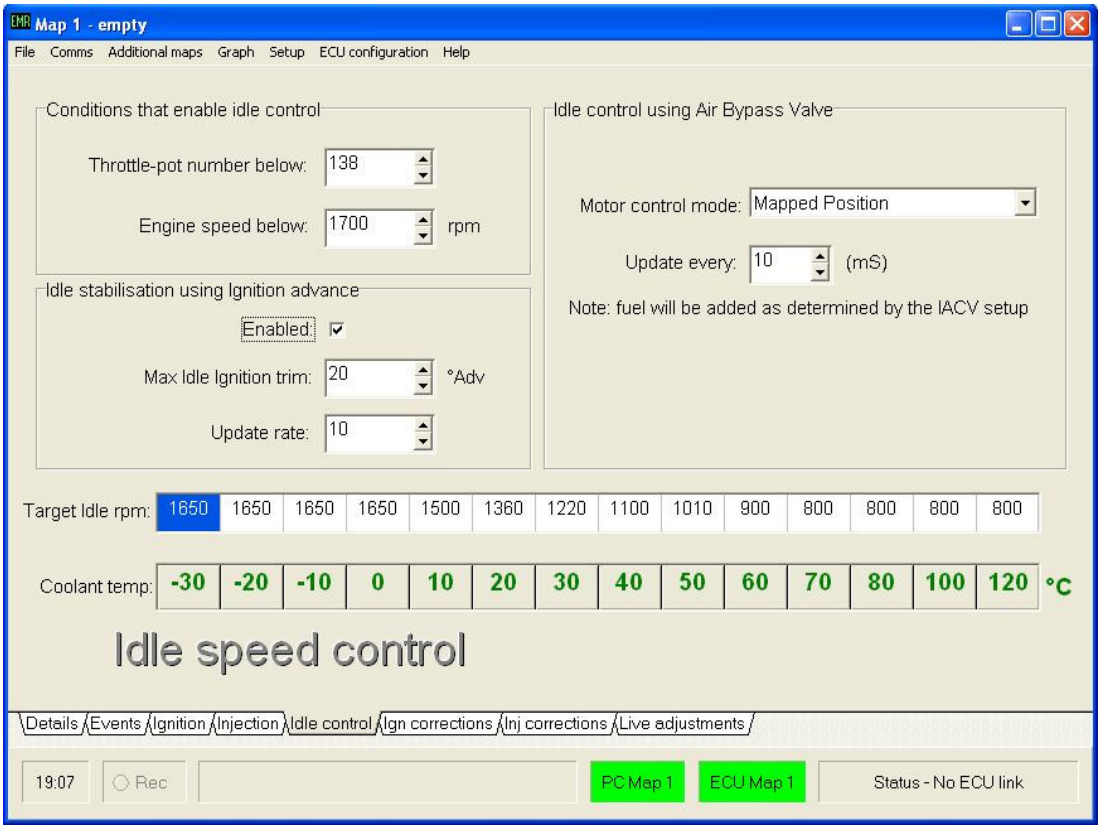
In the majority of cases the “Additional fuelling for IACV position” should not be used so ensure that all values in this table are set to zero – as per the below screen shot. Use the + and – keys to adjust the values within the table and set them to zero if they are not already set as so in your base map. Re-program the map/ECU and return to the “Live adjustments” tab.



The next step for setting up the IACV is to populate the other 2D map – “Base IACV position”, shown in the above screen shot. These values are determined during cold running at the various temperature breakpoints. Starting from cold and whilst running at the various temperature breakpoints, the IACV position should be adjusted manually from the “Live Adjustments” screen (F8) (pgUp and PgDn respectively to open and close the valve) to maintain the desired engine speed.

Make a note of the IACV position value required at each temperature breakpoint and then enter the respective values into the “Base IACV position” table on the “Idle speed control” tab (F5). During this process you may also need to **temporarily** adjust the “Injection trim” (2 to decrease, 3 to increase, 0 to clear the trim) to maintain a clean and smooth idle. Do not save any required trims to the “Base Injection map”. The fuelling enrichment needed for cold running at these temperature breakpoints is determined by the “Coolant temp” table found on the “Inj corrections” tab (F7). This is discussed further in the next section.

With the “Base IACV position” table now fully populated you can now set the “Initial IACV startup pos of:” to a value corresponding to slightly more than the “Base IACV position” value seen at 0 degrees C. This should ensure that the engine has sufficient air during cranking and should result in a mild rpm flair upon starting.

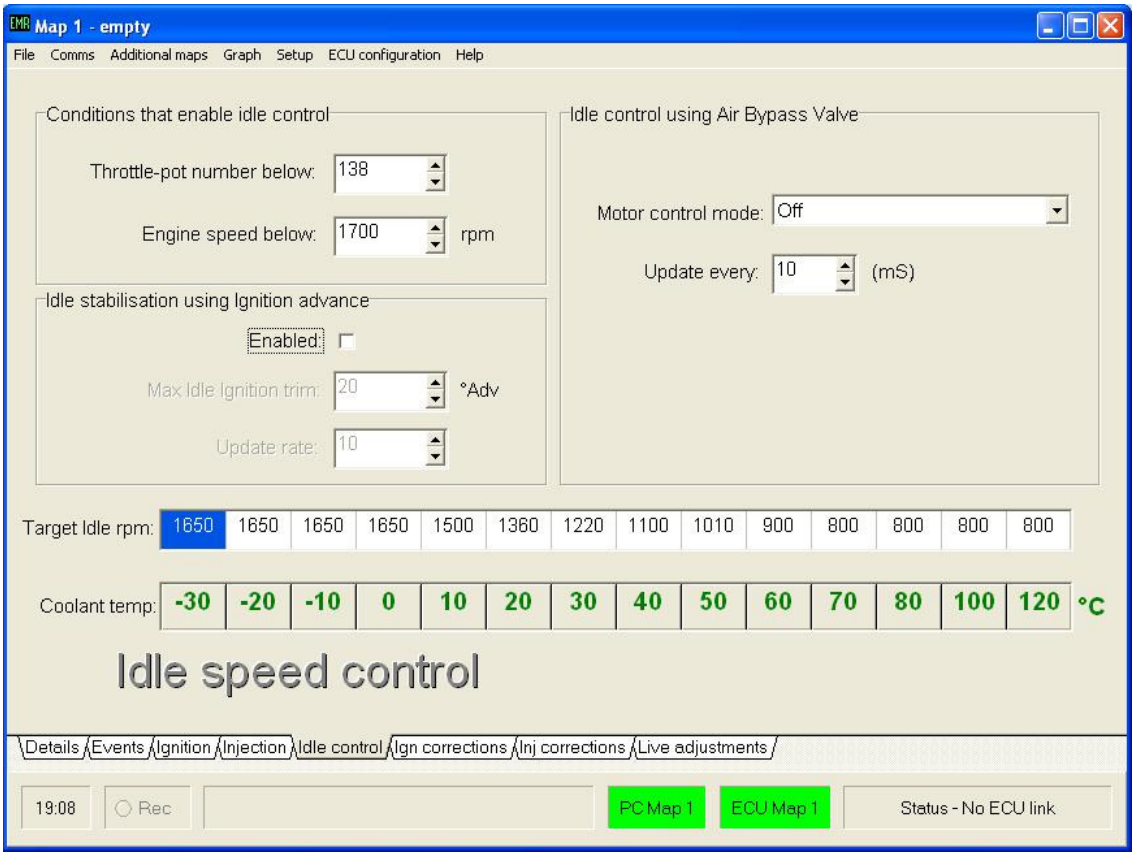


Once all cold running IACV calibrations are complete you can then set the IACV motor control mode to “Mapped position” via the “Idle speed control” tab (F5). Also enable the “Idle stabilisation using Ignition advance” function and use the figures in the below example screen shot as a guide. After making the changes, re-program the map/ECU.

The next time the engine is started the IACV will move to it’s mapped position in accordance with the tables you’ve just worked on and the “Idle stabilisation using Ignition advance” will fine tune the process.

Engines without an IACV.

For engines without IACV's fitted, (which is fairly standard practice on engines using independent throttle bodies per cylinder) the cold start mapping process is simplified somewhat compared to when an IACV is used. As a starting point setup your "Idle speed control" tab as shown in the below screen shot.



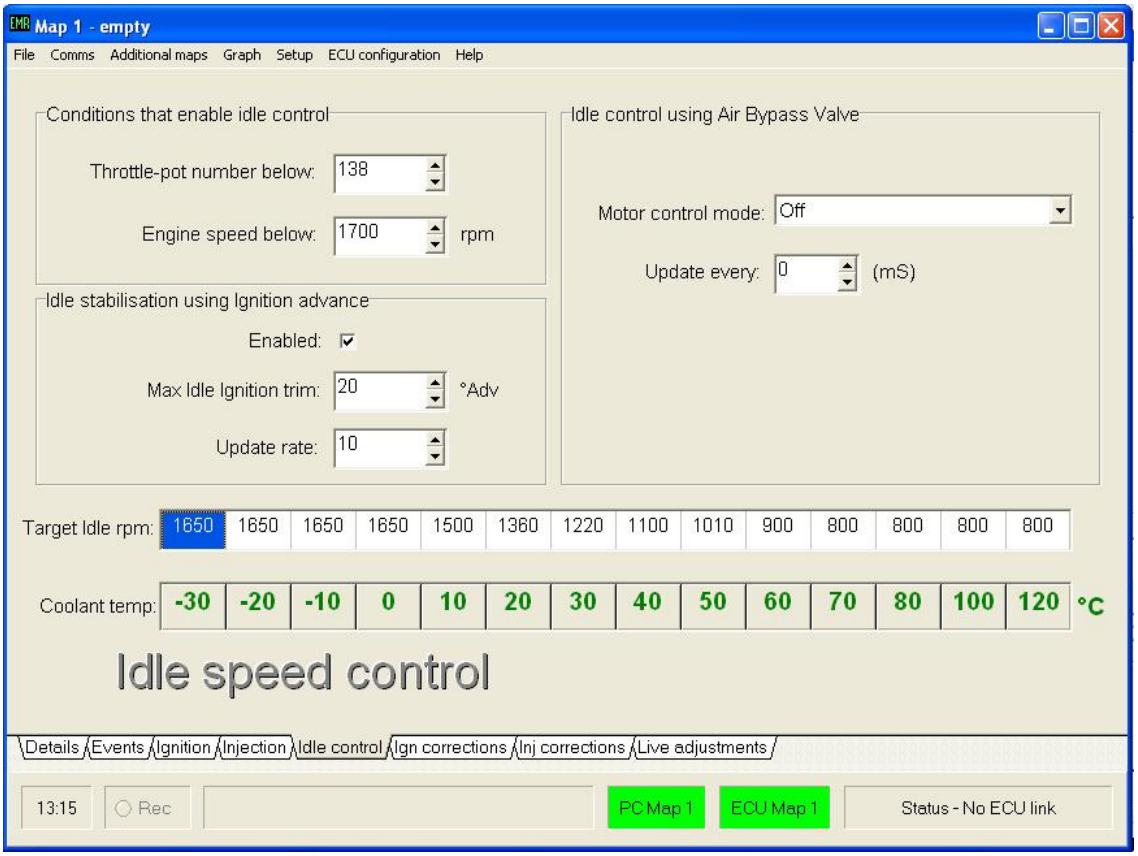
Note that your "Throttle-pot number below" within the "Conditions that enable idle control" area of the screen will be unique to your installation so **do not** set it to match the above screen shot. After making the changes, re-program the map/ECU. Now select the "Live Adjustments" screen (F8) and start the engine.

Use the – and + keys to either decrease or increase the amount of ignition advance at idle (the 0 key can be used to clear the ignition trim), so that the engine is idling with around 0 degrees of ignition. Pressing "Enter" with a trim in place will save it to the map/ECU.

With the engine fully warm and idling, adjust the throttle stop to obtain an engine speed slightly below the "Target Idle rpm" specified on the "Idle speed control" tab (F5) for your engine's corresponding fully warm condition. If required, modify the numbers in the "Target idle rpm" 2D map to suit your engine.

If necessary, also adjust the "Injection trim" accordingly (2 to decrease, 3 to increase, 0 to clear the trim, and "Enter" to save the trim to the map) to maintain a clean and smooth idle. Once any necessary adjustments have been made to the throttle stop, realign the throttle position via the "Throttle Position Sensor" option found in the drop-down "Setup" menu. Follow the on screen instructions to do this.

Revisit the above adjustment loop if required and then proceed as follows.



Go to the “Idle speed control” tab (F5) and now enable the “Idle stabilisation using Ignition advance” function and re-program the map/ECU. This function will now add ignition advance, up to the “Max idle ignition trim” value allowed, in order to help achieve the desired “Target Idle rpm”. After making the changes, re-program the map/ECU.

Cold starting

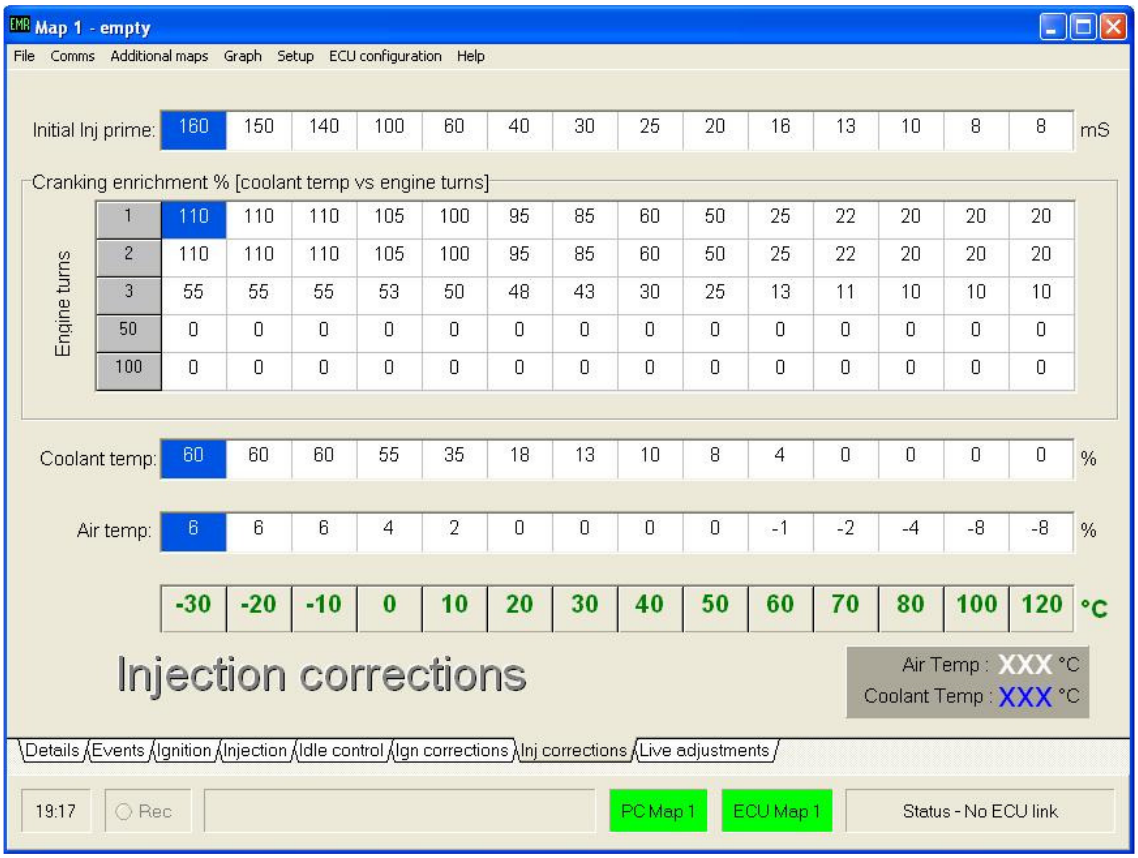
The first thing that is important to remember is that cold start mapping **can only be carried out** once the engine has been correctly set up and mapped at normal running temperature. This is because the cold start strategy works by modifying the base injection map values, derived during mapping, that suit the engines requirements when it's up to normal operating temperature. If these base injection values are incorrect (i.e. the car has not been mapped yet) then it's nigh on impossible to sort out the cold starts effectively. It also means that if work is done on the cold starts prior to the engine being properly mapped, once it is mapped, the cold starts won't be correct anymore and the work will need to be re-done.

Depending on whether or not your engine has an IACV then the relevant mapping/calibration with a fully warm engine must be carried out prior to carrying out cold start mapping. For more information on setting up an engine, with or without an IACV, please refer to the relevant area at the beginning of this section.

There are two aspects to running a cold engine, initial starting and then the warm up period. For example; the engine may fire straight away but stall after a few seconds of running.

Start up and Cranking enrichment corrections.

The first task however, is to get it started.



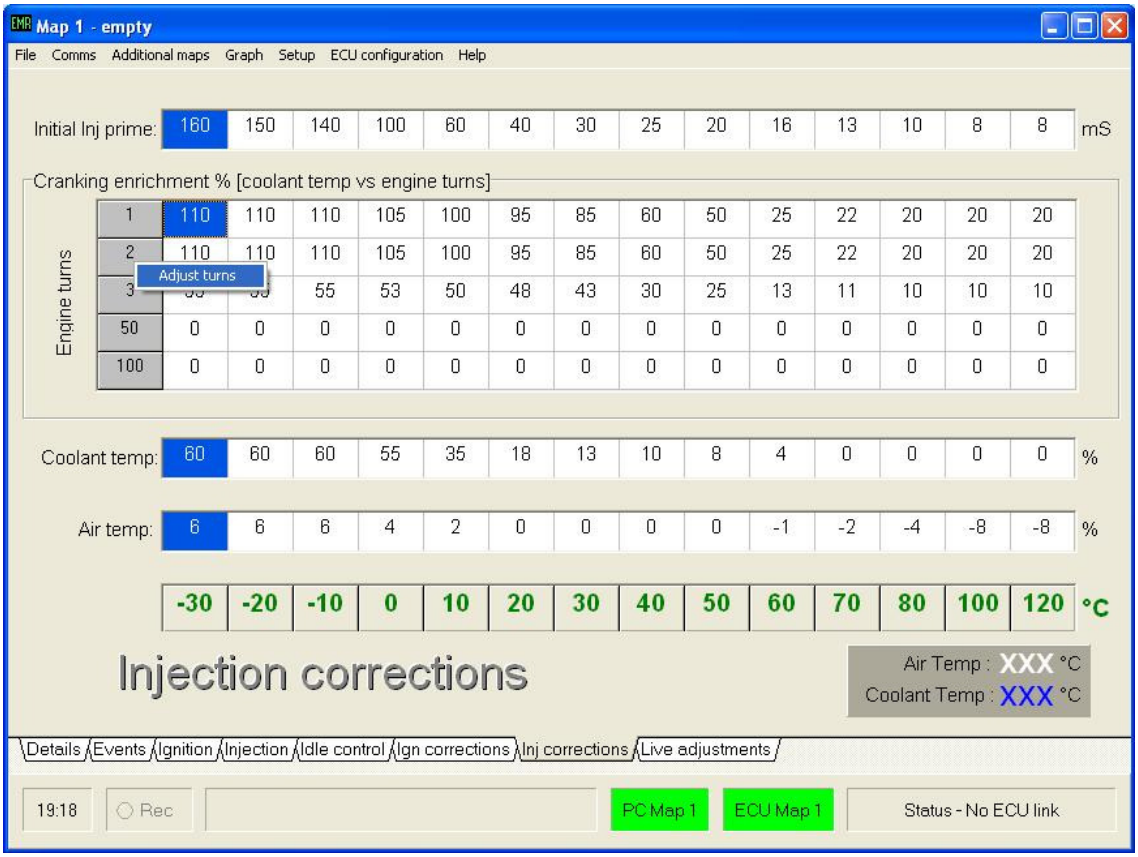
With the Emerald software running on your PC either press "F7" or click the "Inj corrections" tab. This will bring up the "Injection corrections" tab, an example of which can be seen above.

The Initial injector prime 2D table at the top of this screen dictates how long (in mS) the initial injection pulse is. This function is triggered the moment the ECU detects and locks onto the selected trigger

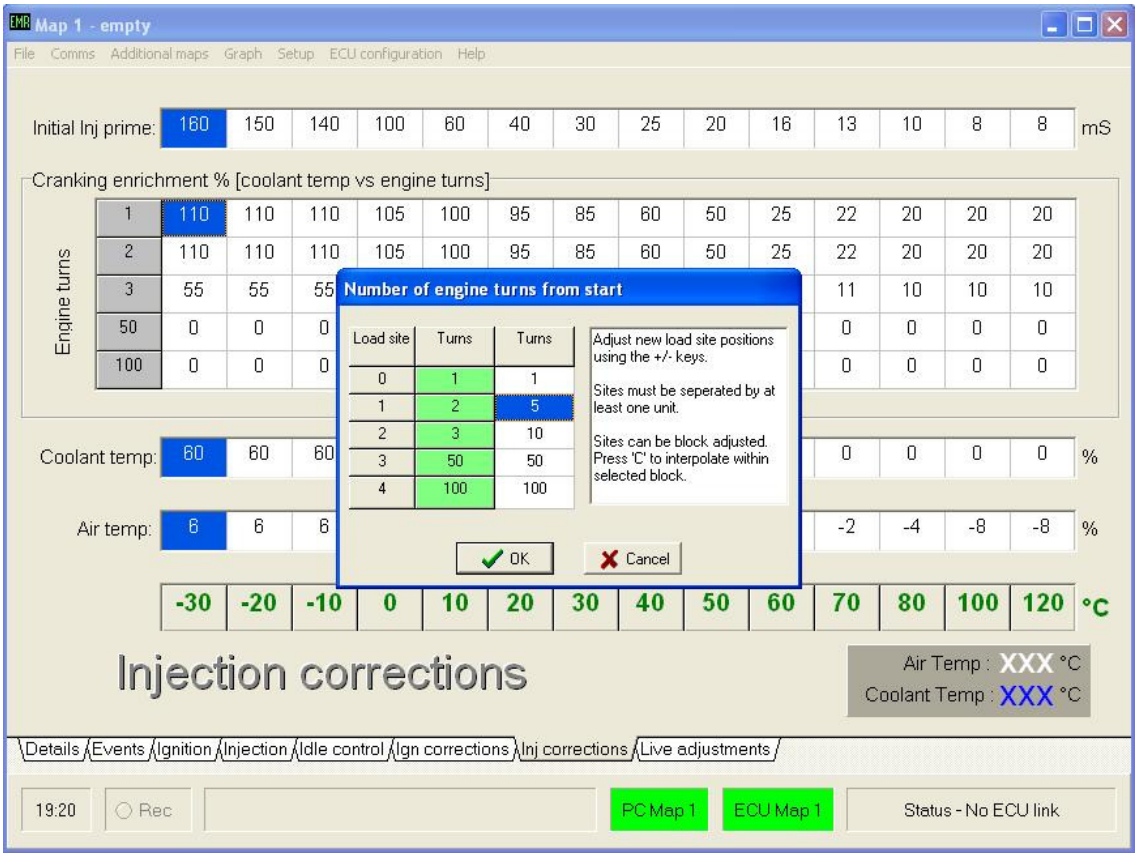
pattern, via the crank sensor. This function has a big influence on how fast the engine starts. With no injector prime, it can take a number of engine revolutions and injection events to fully wet the inlet port so there may be a delay before the fuelling reaches the required ratio for the engine to fire. You can tell when the ECU has locked on as the status LED will turn from red to green.

The figures shown in the screen shot above can be used as a starting point for most engines.

Once the ECU has locked onto the crank trigger pattern it "counts" the number of engine turns and during this period it provides extra fuel in addition to that derived from the base injection map, as a result of the "Cranking enrichment %" table. This cranking enrichment fades away as the engine turns.



If the engine fires and then cuts after a few engine turns, you can increase the number of turns that this enrichment is applied for, and/or change the % of extra fuel injected. To change the number of turns that the cranking enrichment is active for, right click over the grey-backed numbers on the left of the "Cranking enrichment %" table and select "Adjust turns". Via the pop up window that appears make the appropriate changes, for example change to 1 turn, then 5, 10, 50, 100 instead of the default which is 1, 2, 3, 50 and 100 turns.



Coolant Temperature Injection corrections.

Once the cranking enrichment has decayed to zero any additional fuel with respect to cold starting and warm up will be coming from the last two tables on this page, “Coolant temp” and “Air temp” respectively.

To derive the correct numbers for the “Coolant temp” table a few repetitive loops are usually required. To do this procedure properly, between starts, the engine needs to cool back down to the ambient temperature you wish the engine to start at. For most modern engines (depending on the size of the engine), in an ambient of close to zero degrees C, this can mean a soak of anywhere between 8 and 24hrs.

Prior to starting the cold engine, switch to the “Live adjustments” screen (F8) and get ready to adjust the Injection trim (2 to decrease, 3 to increase and 0 to clear the trim). Start and idle the engine. Try trimming in more fuel as required until the engine runs cleanly – **do not** apply the trim to the map. Note down on a piece of paper by how much you’ve had to increase the fuelling, and what the engine temperature is at that point in the warm up cycle. **Specifically note the “Map number” and the “Injection trim” values.**

Stop the engine, turn the ignition back on and move to the “Injection corrections” tab – F7. Note that there are arrows under the “Coolant temp” table showing you the current temperature within the engine. With respect to the coolant temp the engine had achieved when it was running (and where the arrows should be indicating you to) alter the table values appropriately.

The values in these tables are % enrichment applied on top of the base injection map values. To achieve the same fuelling as you had previously using the Injection trim feature on the “Live adjustments” tab you need to do a small calculation!

For example, if your engine was idling with a coolant temperature of about 20 degrees C, had an Injection map number of 50 and you needed an Injection trim of 9 to achieve a smooth running idle, then the calculation is as follows:

Injection map number	+	Injection trim number	=	Trimmed injection number
50	**+**	**9**	**=**	**59**

(100 / Injection map number) x Trimmed injection number = Percentage increase

(100/50) x 59 = 118

This means the engine requires 18% more fuel to be injected at this coolant temperature - in this case, 20 degrees C.

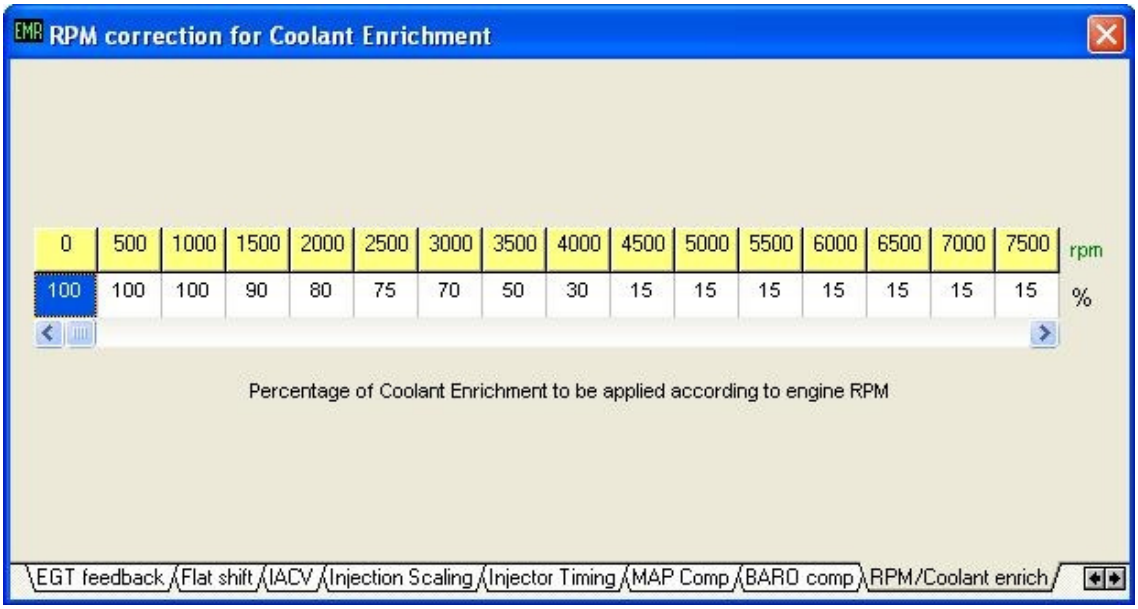
Alter the value at 20 degrees C within the “Coolant temp” table so it is now 18.

Repeat the above process until the engine is fully warm. Normally there will be no enrichment needed after 70 degrees C. It is likely that you will need several attempts over several cold starts to get this right.

Air Temperature Injection corrections.

Determining the “Air temp” correction values by contrast to the “Coolant temp” values is much simpler and easier as you are purely making adjustments based on the fact that cooler air is more dense than hotter air and therefore contains more oxygen. This necessitates more fuel in order to maintain the same AFR. For most cases the values shown in the previous screen shot found on page 8 should provide a good starting point.

RPM Correction for coolant enrichment.



The last area that you need to consider is: “RPM Correction for coolant enrichment”. This is found under the “Additional maps” drop-down menu. This function allows you to reduce the applied enrichment during the engine warm up period as the engine rpm increases. This map is required because as the air speed in the ports increases with a corresponding increase in engine speed the amount of extra fuel added for cold running can be reduced as this additional air speed carries more of the injected fuel into the engine in a form where it will burn (less fuel drop out occurs).