www.ExtraEFI.co.uk

Please read the Settings+Checks file then the SpeedDen or Alpha_N files first on the CD

(Also available on my website!)!

Basics to getting Started

It is important to understand that if the engine doesn't start or fire at all then it is NOT the VE Table (fuel map) that needs tuning, so don't go off and adjust that as yet. The ONLY fuel that goes into the engine during cranking is set by the **Cranking PW**, so if it doesn't fire you will need to look at the **Cranking**. Once it fires and the RPM goes above approx 300RPM then the VE table is used by the ECU.
Start with this check list:

• Always check timing at cranking before getting too carried away with fuel. If the sparks don't come at the right time then it won't start, so check its firing with a strobe at approx 10deg BTDC during cranking. If it doesn't, fix that first by checking/adjusting the **Trigger Angle** in **Spark Settings**, twisting the dizzy, checking alignment of crank / cam sensors, etc.

• Check that you have an RPM reading during cranking on the tuning software screen, it needs to be reasonably steady and around 100-300RPM, if you have no RPM reading then you have a trigger problem, the ECU is not seeing your hall sensor or VR sensor, etc. If this is the case then you need to check your wiring to the VR or hall sensor (the red cable in the screen wire is the signal, the blue or black is the ground, *do NOT connect these together!*). If using a VR sensor you may have to adjust the potentiometers inside the MS ECU, see http://www.extraefi.co.uk/vr_setup.htm for instructions. If you have a hall sensor it needs a 5V or 12V ignition supply, you will need to check what type of sensor you have and see how it was wired in the original setup.

•• If using a VR sensor ensure it is wired up the correct way around, it does matter! If your not getting a good RPM read out despite altering the potentiometers in the ECU, try swapping the cables over from the VR sensor if your unsure which is the signal output.

• Check you get a PW reading on the tuning software screen, this should be wrougly the same as you've set in Cranking Settings. If you get a PW of ZERO then you may have the throttle pot wired up wrong. The ECU goes into **Flood Clear Mode** when youve got your foot flat on the accelerator to clear a flooded condition, this means it adds NO fuel.

•• For ***MS1-Extra*** if the TPS is OK but you still get a PW of ZERO then check the setting for **TPS for Flood Clear** aren't set too low in **More Cranking Settings .**
•• For ***MS2-Extra*** *and MS3* simply calibrate the throttle sensor by going into **Tools - Calibrate TPS** with the engine ECU connected. Click on **GET CURRENT** for closed then fully open throttle (obviously not with engine running) and it will calibrate it for your TPS.

• If you need to open the accelerator during cranking (foot on throttle a little) and then it starts you are adding too much fuel during cranking as you are letting in more air to weaken the mixture with your foot. So reduce the Cranking PW time at the relevant temp setting.

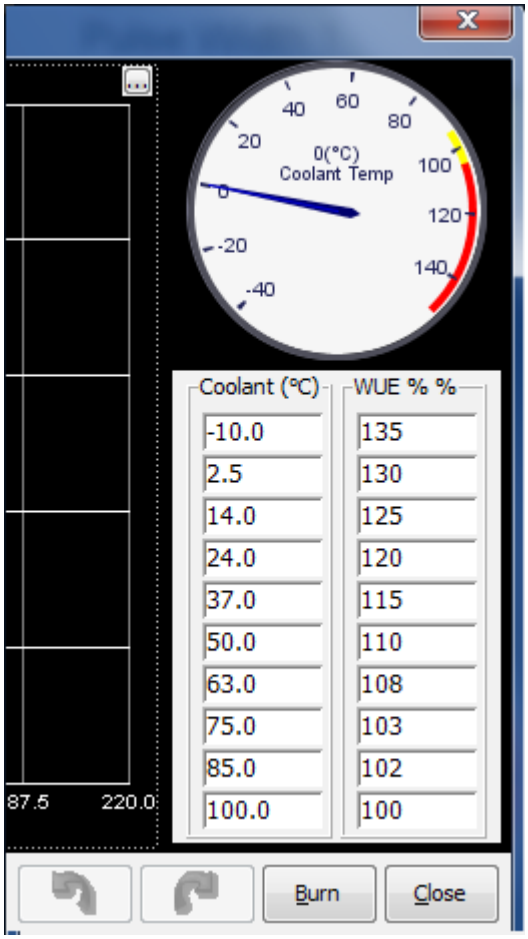
• If it doesn't fire despite what you do with the throttle it will probably need more fuel, only add a little at a time, 0.2mS increments.

• Ensure the ECU still has power when cranking, I've seen an ECU wired up to the radio supply, this is usually switched off during cranking so the ECU has no power, obviously it will never start like this!! *The dials in the tuning software will go blank "--" if the power is lost to the MS ECU.*

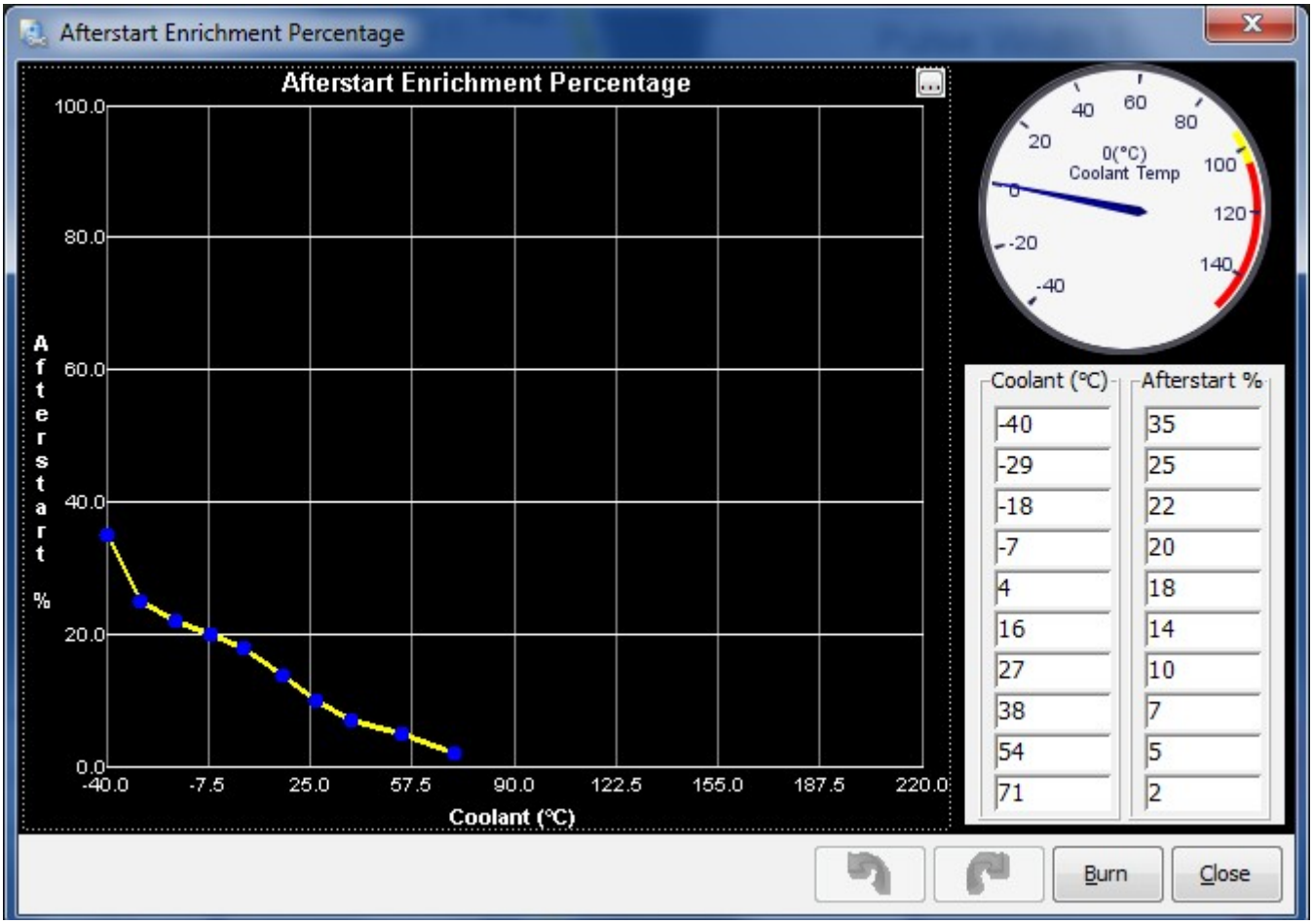
*It is a good idea to set the **Priming Pulse** to ZERO whilst tuning, the **Priming Pulse** adds a little amount of fuel to prime and bleed the injectors on power up. This can soon flood the engine whilst you are tuning as you will turn the ignition on and off a lot!*

If you are starting the engine for the first time then it is recommended to adjust the **REQ_FUEL** (in the Engine Constants page) to richen or lean the engine until it is warm, an increase in REQ_FUEL richens the mixture across the whole map, a decrease in it leans the mixture. **(NOTE: Press the TAB button and then press BURN TO ECU to force your settings into the ECU)** We recommend using the REQ_FUEL because you can then re-tune you VE table to keep it all smooth for a good starting point, if you adjusted the VE table to keep it running then the chances are your idle areas would be either very high or very low compared to the rest of the map. Once you have the engine warm you can set the REQ_FUEL back to the calculated or original value, BUT you then will need to reset your VE table to compensate. (Basically the REQ_FUEL increases/decreases fuel over the entire map, so when you reset it you will need to change the VE table so the same amount of fuel is added) To do this, ensure the ECU is powered up but engine is not running. Remember what the REQ_FUEL value is for a reasonable idle (in other words what the value ended up being while you were adjusting it to get it to run OK for the first time), then change the REQ_FUEL back to where it should. Next go to the VE Table and select "**TOOLS - VE Specific - Reset ReqFuel**" and set the **Current ReqFuel value** to the value you remembered from earlier and the **New ReqFuel value** to the calculated or original value. When it asks you to burn select YES, this will then adjust the whole VE table, in the case below the VE values will increase to compensate fro a decrease in REQ_FUEL, so you should end up with a good smooth map to start tuning from.

WarmUp Enrichments:
Once you have the idle tuned when warm don't touch it again while the engine is cold!! Only adjust the **Warmup Enrichments** to get a nice idle / running engine when the engine is cold. This enrichment is basically additional fueing thats added ontop of the fuel map (VE Table) to richen the mixture when the engine is cold. 100% would mean it uses the fuel map, 110% means it adds 10% to the fuel map, etc. So next time you start it from cold get ready on the warmup enrichments page. These will need tuning for your car, a good base setting is below.



After Start Enrichment:
Once the engine fires up from cold keep it running using the throttle and Warmup values as above, once your happy with this tune (it will take several days to get this right as the engine needs to be stone cold) and the engine starts from cold and runs smoothly up to operating temp then you can start with **After Start Enrichment**. This is added for a short period of time just after the engine starts, (defined by engine RPM greater than the setting in "**More Cranking Settings**" typically 300RPM), the engine starts to use the VE Table's fuel map and if the coolant is under 71C (170F) it goes into afterstart enrichment. The afterstart enrichment is generally set to increase the percentage of the fueling map it will run at for a pre-determined amount of time or ignition pulses so the engine has a chance to start and smoothen out. This can be set to a different value depending on the coolant temperature in **"After Start Enrichment Settings**" Start out at a user-defined percentage enrichment value (typically around 25%), and then it ramps down to 0% after so many ignition trigger events, which is user-defined (use about 200 for this number to start). This is an enrichment above the normal warm-up enrichment, which is temperature dependent. Please note that 0% means that it will run exactly what the VE table values are and 50% would mean 50% increase over the VE table.



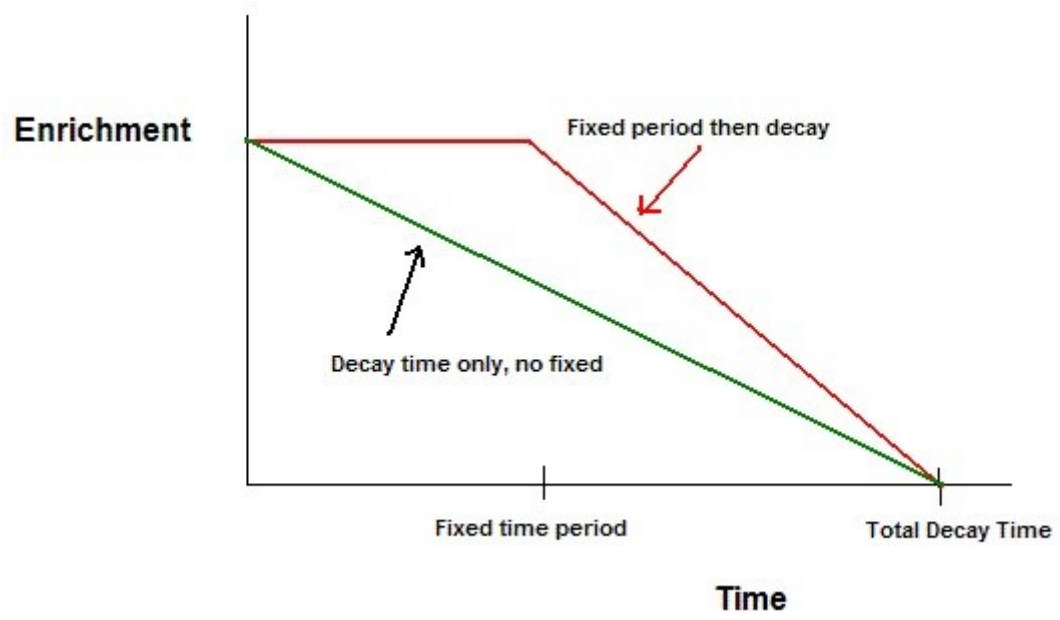
If the engine starts and runs for a few seconds, then stalls, this is usually a sign that the afterstart enrichment isn't quite right. Leave everything else the same, and adjust the afterstart % and number of cycles. 20% to 30% and 200 cycles are reasonable starting points for most engines, but yours may run better with more or less. There should be a point at which it works without stalling.

If the engine starts and runs for more than 20 seconds or so, then stalls, you need to adjust your warm-up enrichment bins. As you adjust your warm-up bins, you may need to re-adjust the afterstart, since these interact (i.e., a larger warm-up value may require a shorter or smaller afterstart enrichment).

It's been found that during winter the cranking and after start enrichments need tweaking in order to get the engine to start and run without restarting it several times from cold. The reason is felt that the after start and cranking enrichments don't necessarily follow temperature in a linear format. You can therefore select CLT - MAT or an average of the two for the Cranking PW to reference.

After Start Enrich Counter is the length of time in Seconds or engine cycles that the after start enrich runs for. The percentage added is decayed down to zero as the time expires

Set **ASE Mode** to **FIXED** for a timed period of ASE that does not decay, after the timer the ASE will then decay as usual during the **TOTAL ASE** time period that's left. This has a temp setpoint as it should only be needed when the coolant temperatures are fairly low.



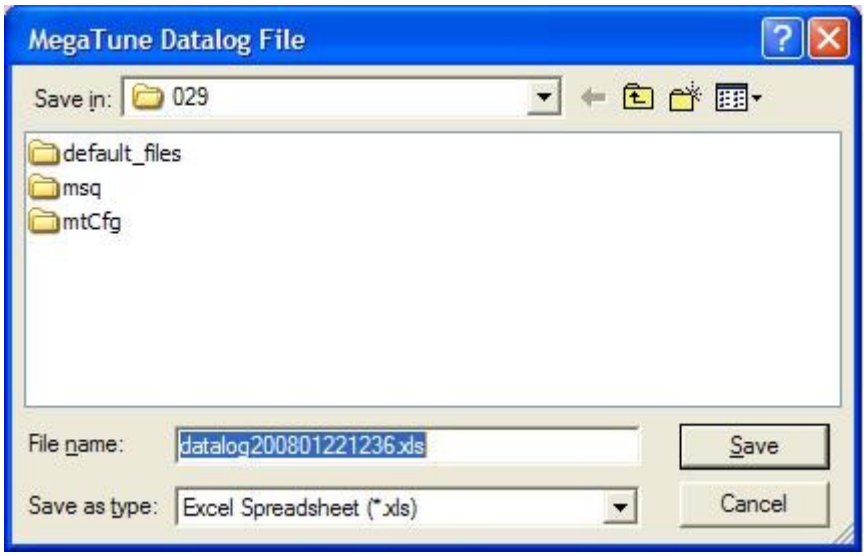
Please Note: If you have lo-impedance injectors (less than 4 Ohms) , after getting a good idle you need to adjust the PWM duty cycle on the Constants Page in MegaTune down in 1% increments until you notice a change in idle quality (be sure to hit the "send to ECU" button each time you change the value). This is the point where the current limit is too much and the injectors are not being held fully open. Then move the value back up 3 - 5% (for example, if the idle falters at 45%, then put in a number of 48% to 50%). Move on to adjusting the time threshold. Lower the time threshold by 0.1 milliseconds at a time until the idle quality deteriorates. Then increase it 0.3 ms.

Don't start driving until you have a good stable idle, it isn't very safe to drive a car which won't idle. Adjust the fuel map once the engine is warm to get a strong idle, you should use the Live Mapping theory below to get a smooth idle, it will probably be a little rich, don't worry too much to start with. At idle a small change in the VE value can change the mixture a lot in some cases, so take time to adjust this and give it time to react.

Tuning the VE Table Off-line

The MS ECU's will naturally datalog the inputs from TPS, O2, Coolant Temp and the Air temp sensor, as well as the fuel PW, engine speed, clock timer, Dwell, Spark Advance, etc, etc, etc, there are in excess of 20 seperate streams of data that MS1-Extra logs (MS2-Extra and MS3 logs even more) These are logged onto a laptop whilst it's running the datalogger. To datalog you need the tuning software running and select **File -- Datalogging -- Record** or **ALT-L**The default file name is a time/date stamp. Once you select **SAVE** it starts datalogging a file with all the above parameters being logged. The bottom right corner of MegaTune shows LOGGING highlighted in black. It should be noted that MS3 can datalog to

an onboard SD card, this can be switched on by an external input or through the tuning software. The rate of storage is much higher with MS3 than any other MS ECU.



The file is saved in an xls (excel) format. This can be opened in Excel if you wish, but it's better to use MegaLogViewer, this is a superb program and can help you tune your engine quickly. If using a **WideBand lambda sensor** and **MS1-Extra**, make sure you select the correct wideband sensor from the list in MegaLogViewer from the drop down menu in **Calculated Fields - WideBand O2 AFR** tab. If using a narrowband you don't need to do this. If you're using MS2-Extra or MS3 then the ECU would have sent the actual AFR rather than the voltage so no conversion is needed.

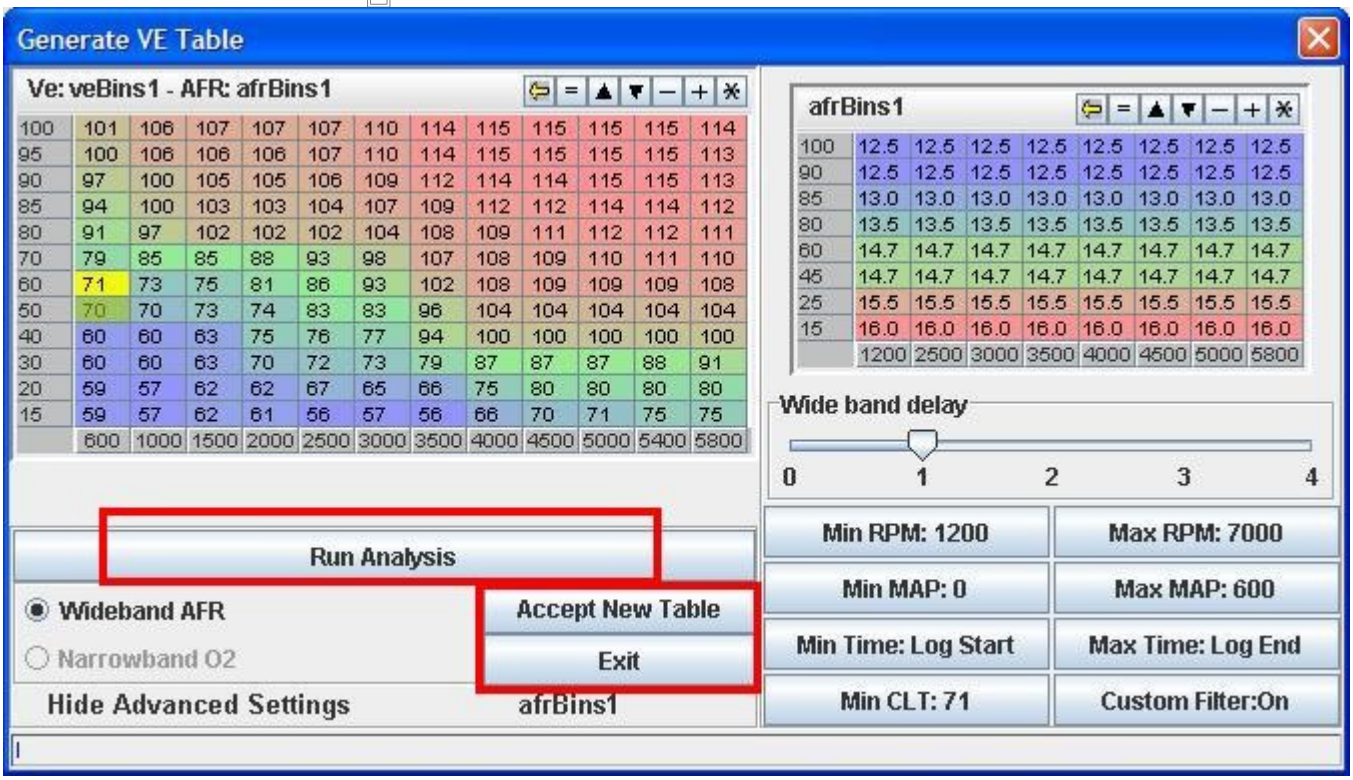
Once you have datalogged a gentle run in the car, pull over to the side of the road and shut the tuning software down. Open MegaLogViewer and open the datalog**.** Then select **Open MSQ** and select the msq you were using at the time the log was made. You will be able to see on the datalog where the engine was running lean or rich, etc, by moving the log around looking at the O2 reading and watching the highlighter move on the VE and Spark tables. This gives you the points to adjust on the VE table. If you want to try the **VE Analyser**, which is highly recommended, select it and select **Run Analyser**. Obviously if your using a wideband lambda the results will be far more accurate and you can then change the AFR targets in the MSQ. If usin a narrow band the targets are a little harder to get as the sensor doesnt really give any information other than rich/lean of 14.7 AFR.

Before datalogging;

• Turn the Accel Enrichment off, by setting the thresholds to an excessive amount, e.g. MAPdot 1000 or TPSdot to 1000V/Sec in the Accel Wizard.

• Turn EGO Correction ON when using MegaLogViewer, see HERE for more on how to set up the O2 correction (EGO).

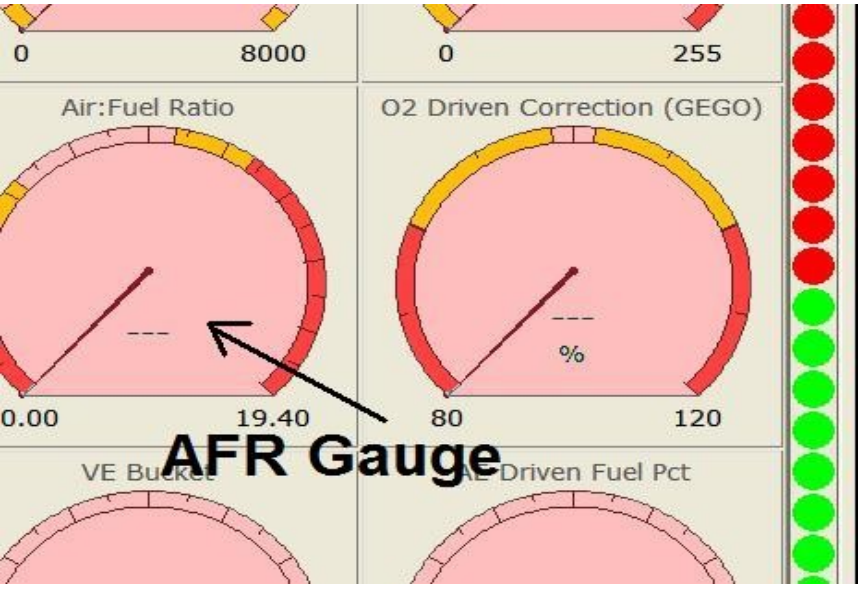
• Ensure the engine is up to operating temperature before logging, this ensures you only tune the VE table and no additions are thrown into the mix.

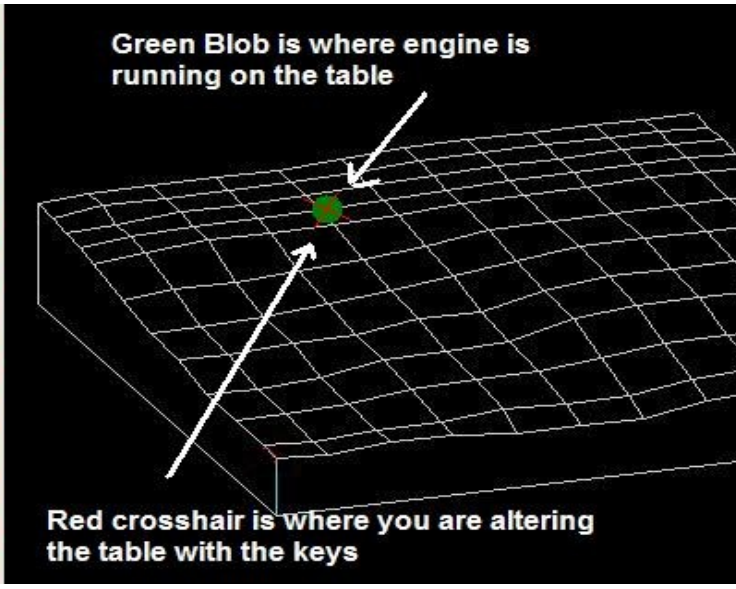


After you've run the analyser the VE table will have several red numbers, these are the values that have been changed by the analyser. Basically it looks at the AFR for the points of the VE table in the datalog and decides how much to change them depending on the average value of the AFR in the datalog. Click on **Accept New Table** and then **EXIT**.Save the msq **(Save MSQ As)** and then close MegaLogViewer. Turn the MS ECU back on and open the new msq file in MegaTune, Burn it to the ECU and your ready for another datalogging session. It is highly advisable to start at low loads and revs, do several logs and only move on to next rpm range slowly when the changes become small in the analyser.

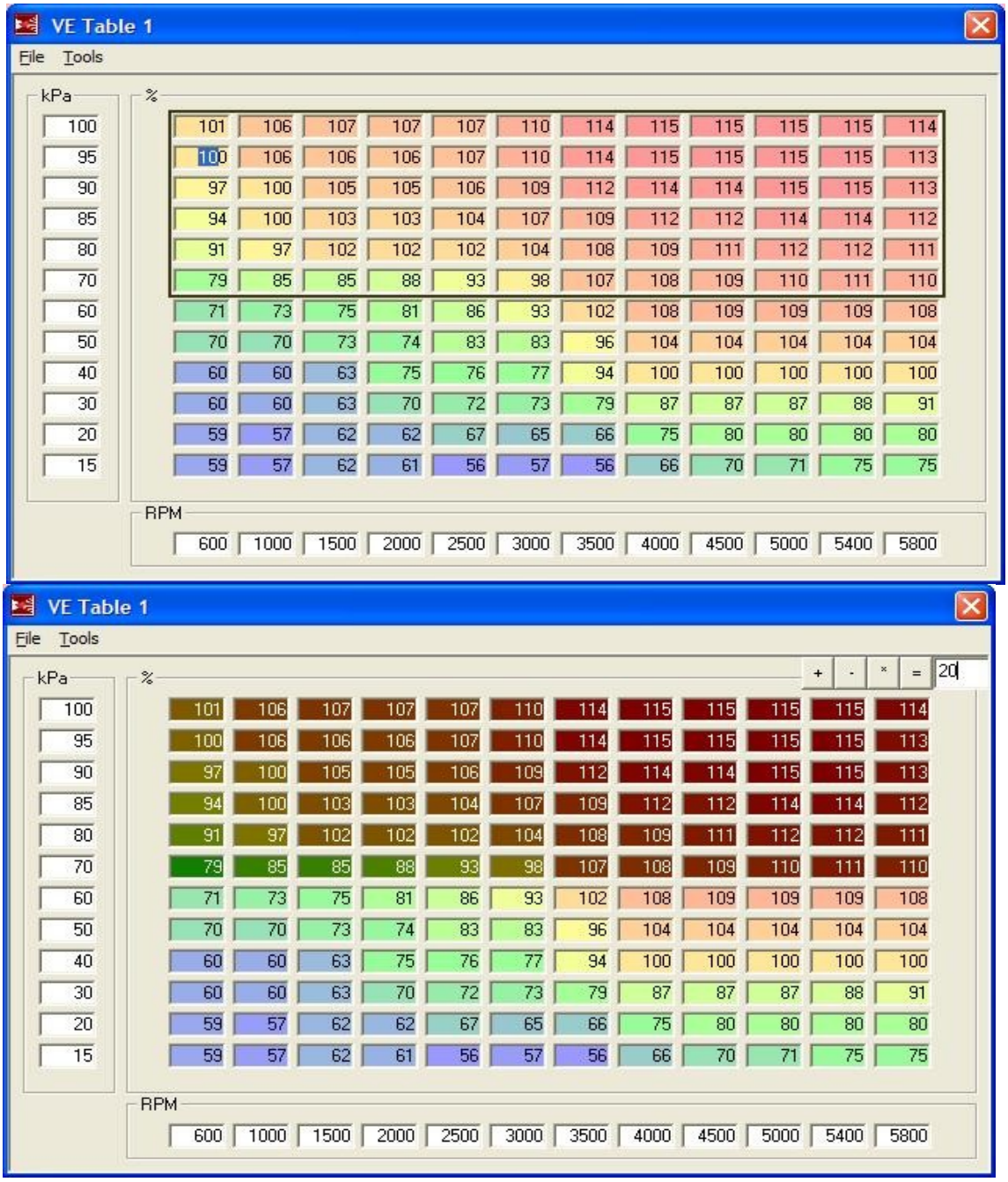
Tuning the VE Table Live

This is by far the best method of tuning, but it does take 2 people to do it, one to drive, the other to operate the laptop.
Ensure the engine is up to operating temperature before starting tuning the VE table so that there are no warmup enrichments added to the mix. Also turn the accel enrichments off by setting the MAPdot to 1000KPa and TPSdot to 1000V/S so that all your tuning is the VE. I always turn the EGO correction off so that theres no correction going on, to do this goto **Basic Settings -- Exhaust Gas Settings** and set the **Controller Step Size** to ZERO. Now all your going to tune is the table, the corrections can be turned on again later once the table is tuned.A lambda sensor is critical to tune any engine unless your a real expert! A wideband lambda will make life so much easier too.Start by driving slowly, keeping load low and engine speed low untill your happy that all is OK then move upwards. To tune the VE table live there are a couple of options. The best way is to use the 3D display (MegaTune **Tuning -- VE Table**) and drive to each cross point tuning as you go, this will need a driver and a passenger!! The green blob is where the engine is on the map and the cross hair (RED) is where you are tuning, so use the arrow keys to go to the points you want to tune. Use the AFR gauge in the left side of the screen to see what the mixture is doing and increase or decrease the points where the green blob is to get the AFR correct. To increase the value (richen) press the "Q" button to slowly increment it or the "E" button to increase the value by 5. Like wise the "W" button decreases it and "R" leans it off by 5 in one go. By gradually driving and tuning the points you will soon get a feel for what is needed. Its impossible to tune all the points, as its unlikely youll drive at light throttle at 6000rpm, etc, so you will have to estimate the table at some of the points. The table should slowly increase in value as you go up the KPa scale and also increase in value as the RPM increases, it may fall off slightly as you pass the maximum torque point.





If you start off and you find your having to drastically change the values then it may be better to pull over and adjust the entire table in the same direction before going too far. So say you've had to add 10-20 to the first few points, you will find the entire map will probably need the same doing before you can fine tune it.To do this pull over and close the 3D table down, and open the **VE Table in Basic Setting -- Fuel VE Table1**
As the engine should have already been tuned for a good idle leave that part alone for now. All we need to alter is the parts where you feel were a long way, so if cruising at 2000RPM was nearly OK but as soon as you went up the load a little it went weak you will need to increase the table all the way across the rev range but only above crusing KPa. To do this move the mouse cursor to the start of where you want to alter (e.g. 100KPa - 600RPM) and hold the left mouse key down, drag across the VE table and a box will appear. Position the box so it is all the way across the RPM range above the crusing KPa.



Now we have the area to increase highlighted and a box appears in the right corner which we can use to change the highlighted area. In this case we want to add say 20 to the area, so we will enter 20 in the box and hit the "+" on the screen. Equally we could decrease it by 20 by pressing the "-" or times it by say 1.05 or what ever. The "=" would set all the highlighted range to 20 in our example. **It is important to note that untill you "BURN TABLE" the changes you make will be lost if you turn the MS ECU off, so select File -- Burn to ECU every so often or "ALT - B"**The AFR your looking for will be different for each enine, but as a general rule of thumb 14.7 AFR is the most efficient mixture and is used for cruising, overrun can be a weak mixture but you may experience some poping through the exhaust if you go too lean. Max power is usually produced at around 12.5-13 AFR, a turbo engine may need 11.5 to cool the valves, etc. I tend to aim for 13-12.5AFR above 80KPa when tuning a NA engine.

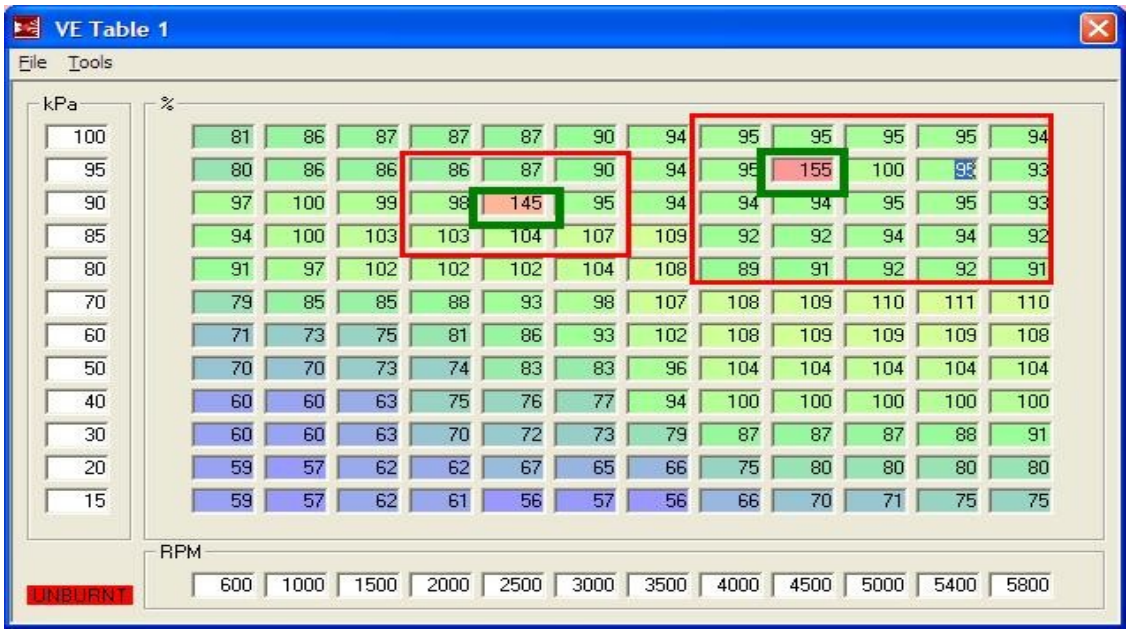
Auto Tune

Auto-tune is a feature inside MegaTune that can check your EGO correction and alter the fuel map. It can be found under **Tools** in the **Tuning VE Table** section. Although many people have had a lot of success with this feature and I'm sure I will be shot for saying this, I don't think this is something you should get too carried away with as it can tend to create some pretty bad maps if it's not used correctly. I feel it's main purpose is to fine tune a map that is almost there. The trouble I've found with it, is there's little way of knowing whats been changed whilst you drive. It will only tune the area you are driving at so the fuel map could end up being very lumpy due to the tuning being altered where driven and no changes else where. Looking at the map you would never know what areas had been changed so you wouldn't know where to smooth off, etc. I recommend staying clear of this unless you really know what your doing. It's not an answer to tuning by driving up and down the road running autotune.

There is also a new function within Tuner Studio **"VE Analizer Live"** that is still experimental but is worth trying once the table is close. It has limits that you can set for RPM range, KPa, etc, so you can allow it to tune certain areas of the map. I would guess this will eventually work out as the route to take as development time is spent on it.

Finalising your VE Table

Once you've done a few datalogs and run them through the analiser or your done some live tuning, you will probably notice the map has only been tuned where you drive, so the low KPa areas of 5000+RPM would not have been changed and some other areas may have been missed. This is because you dont drive there, but to keep the map lookin good it is a good idea to look at it every-so-often during tuning and smooth it out a little if theres large lumps or if it leaving small numbers next to large ones. To do this simply look either at the VE Table in Basic Settings or in the 3D graph. If you look at the VE table above, youll see a smooth increase in value as the RPM increases and as the KPa increases, this is how it should be, if you have anything like below it may be that the values around the large numbers need increasing and that value may need decreaseing as it is probably compensating for too small values around it.



In th example the numbers no longer increase with KPa like they should and theres a couple of large numbers next to numbers a lot smaller, this isn't right. Start by smoothing out the numbers around it and re-tune those points, ensure your Accel enrichments are off, etc. Don't be too worried by this, the example is an extreme just to show you what to look for.

Once the VE table looks good and the car is driveable start turning on the EGO correction and Accel Enrichments. Start with small amounts of additional fuel, maybe at the bottom 0.2mS -- 0.8mS -- 1.4mS and at the top 1.8mS. It can be surprising how little fuel is needed for Accel once the VE Table is tuned.

Final Settings in MegaTune or Tuner Studio

Once the VE table (fuel map) is tuned you can now turn a few things back on in the tuning software to complete your installation.

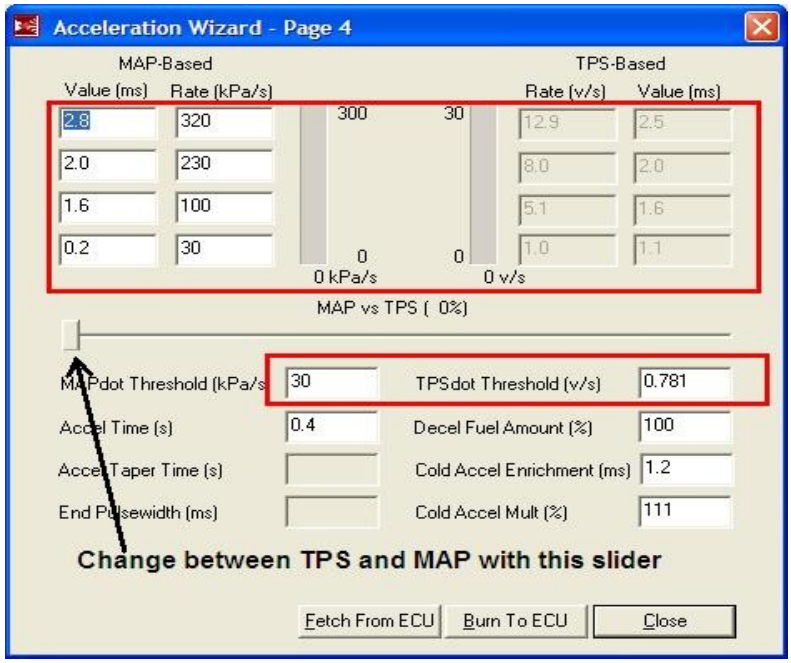
• **Acceleration Enrichments (AE):**

Set the thresholds up for either **TPSdot** (Change in TPS Voltage/Sec) or **MAPdot** (Change in MAP/Sec) so that the AE cuts in when you push the throttle down fast, this usually creates a lean moment where the fuel is stripped from the intake walls due to a sudden change in pressure. The AE is used to add fuel to fill in the hole where it goes lean. Most people tend to find MAPdot is the best settings unless its a highly strung motor that revs extreamly quickly, then TPSdot is better. Most manufactorures use TPSdot, so try both. Remember that the higher the threshold value, the more change in TPS or MAP is needed to trigger the AE, so very low values mean it will trigger easily and probably when you don't need it, and very high values will mean it won't cut in unless you stab the throttle very fast!

Start with the lower mS values at the bottom and the higher values at the top of the tables. I've found the below settings are a very good starting point, the lowest value should be quite small.

The **Accel Time** shouldn't usually go over 1.0S, usually 0.4 - 0.7S is fine. This is the length of time that the AE is added for, so it will fill in the hole created.

The **End Pulsewidth** (Decay mode) is a great way to taper the AE down with time, usually this is set to 0.0mS, in MS1 it can be found under AccelDecel Mode, where as for MS2-Extra and MS3 it is in the Acceleration Wizard. This allows the AE to reduce the fuel down as time decreases, so the AE PW decreases over the **Accel Time** period.



Deceleration Fuel Amount: This is the percentage of the fuel it uses when it detects deceleration. So 100% would be normal, 50% would be half the fuel. If using a boosted engine Id recommend leaving this at 100% as you could trigger decel in boost by just backing off the accelerator a little but whilst still actually accelerating, this would give a lean condition, which isn't good in boost. For NA cars 70-90% is the norm.

Cold Accel Enrichment: This is a linear addition thats added to the Accel PW depending on the coolant temperature. If you set it to 1.2mS then at -40F you will get the full 1.2mS added to the PW, this decreases up to Zero at 71C.

Cold Accel Mult: This is the same as the Cold Accel Enrichment but it multiplies the PW in the same linear format

Pulse Width = Req_fuel x MAP x VE + (AE x CAM + CAE) + ...

AE = Acceleration Enrichment

CAM = Cold Accel Enrichment

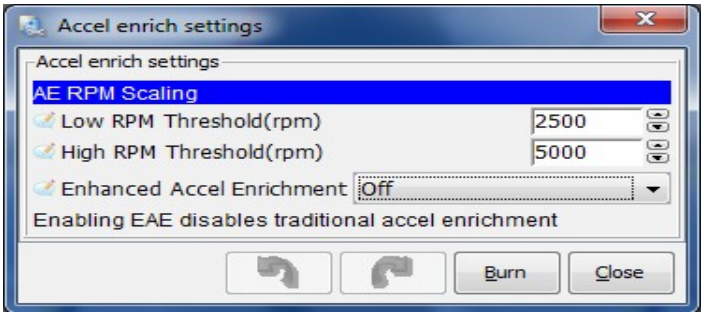
CAE = Cold Accel Multi

If your using Tuner Studio then you can see a histogram graph. This is excellent to work out what rate of change happened when you pushed the accelerator so you can find out what value to put into these thresholds.

For MS2-Extra and MS3 you can also blend the style of Acceleration trigger from TPS to MAP, using the slider in MT or the Percentage in TS. 0% is all MAP based, 100% is all TPS based, anywhere else is a percentage blend of the two.

Acceleration Enrichment Settings page:

This is for **MS2-Extra and MS3** only. It allows the Acceleration amount to be scaled down with the engine speed. So in the example below, the Acceration enrichment percentage will be 100% of the PW from the table, like usual, until 2500rpm, then the amount of fuel added will taper off to 0% at 5500rpm. This is because the engine should need less fuel added at higher speeds.



MS2-Extra and MS3 also have an Enhanced Accel Enrichment that is worth playing with once you have finished all tuning, keep it OFF for now.

• EGO Correction (lambda/O2 sensor):

This is used by the ECU to correct or fine tune the VE table whilst the engine is running. It is not to compensate for a bad fuel map! The **Controller Authority** shouldn't be set above 10% (this is how much it will alter the fuel map by), use the settings below to start you off if you have a narrow band. If you don't have a sensor then set the **Controller Steps** to ZERO..

•• If using a narrow band lambda sensor (99% of cars have these) then the EGO feedback will simply only tell the ECU that it is rich or lean of 14.7AFR, so the EGO correction can only be used for cruising loads. Don't fool yourself that your sensor will tell you anything more than that, it wont.

•• If using a Wideband then the sensor tells the ECU the actual AFR over the whole spectrum. So the EGO correction can then use a AFR table to target different AFRs at different loads. 12.5-13 produces max power and 14.7 is the most efficient (cruising loads)

EGO Sensor Type : Narrow Band or a Wideband. A wideband's output works in the reverse to a narrow band, hence why you need to tell the MS which one you have.

EGO Switch Point: This is to tell the MS ECU what voltage stoichiometric (14.7AFR) is from the sensor you are using. It is 0.5V on a narrow band.

Ignition Events per Step: set this to a value that would switch about 4x a second at your average cruising speed.

4 cylinder assume 3500rpm cruise set Ignition Events per Step to : 29

6 cylinder assume 2500rpm cruise set Ignition Events per Step to : 31

8 cylinder assume 2000rpm cruise set Ignition Events per Step to : 33

You can calculate your:

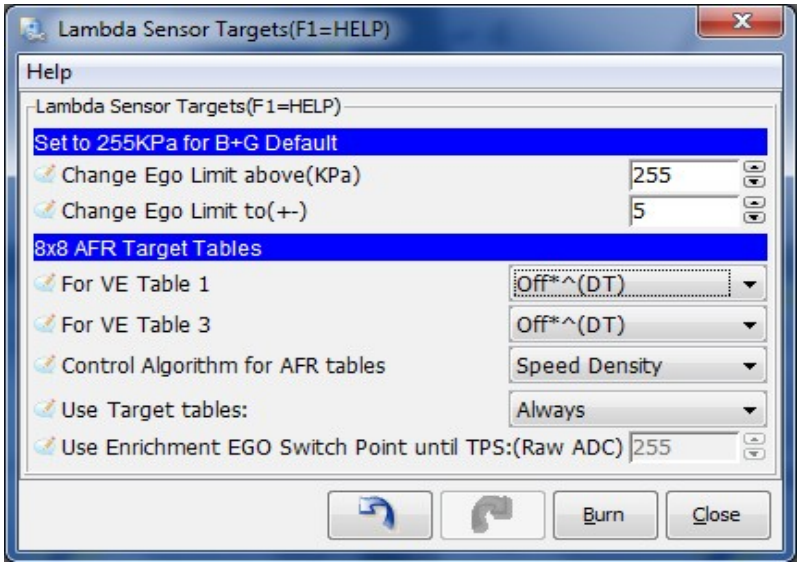
O_2 adjustments per second = ((rpm/120) * cylinders) / ignition events per step

Please Note:
If you decide to run without a lambda sensor (either you remove it after tuning or your tuning on a rolling road without a sensor) then set the Controller Step Size to ZERO!!

Controller Step Size: This is how much the ECU will adjust the fueling by, so if the engine is leaner than the target point it will add 1% to the fueling table. If it is rich it will decrease fueling by 1%. It then waits for the Ignition Events timer before doing the same again.

Controller Authority: This is the maximum the ECU is allowed to adjust the fueling in either direction (Lean or Richen)

In MS1-Extra there is also a function to change the facility to change the EGO Authority limit when above a certain KPa (boost) value. This is mainly for boosted engines when the lambda could be reading slowly and you don't want the EGO to correct by as much as it can when cruising. In this box you will also find the Target Table selection. If using a wideband then select **For VE Table 1 as ON,** this will enable the target AFR table, so you can get the ECU to aim for different AFRs depending on load, etc. The **Control Algorithm for AFR Tables** needs to be set the same as your Constants page (Speed Density for MAP or Alpha_N for TPS based setups)



If using a **Narrow Band** sensor, these usually have 1-4 wires, the heated versions are the better ones to use. A narrow band sensor will give an output of 0.5V when the mixture is at stoichiometric (14.7AFR), this is the most efficient mixture for cruising so should be used as the EGO Switch Point in the Exhaust Gas Settings.

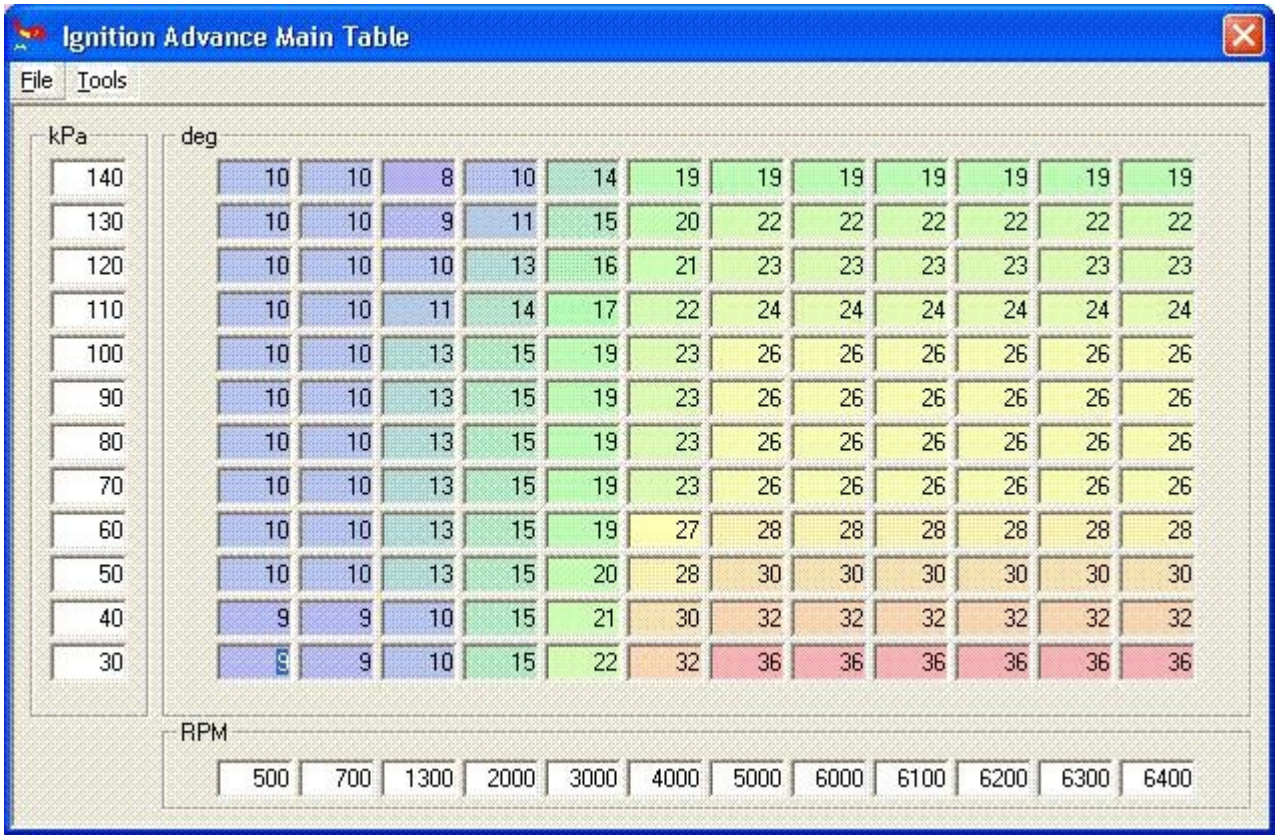
If you're using a **Wide Band** lambda sensor and controller then the ECU can correct the mixture at various loads using an AFR Target Table. These tables can be set for use in **Lambda AFR Settings** for MS1-Extra, in MS2-Extra and MS3 ECUs they are automatically used when you tell it you have a WideBand lambda.

If you chose not to use the AFR table in MS1-Extra, then simply find out the sensors output at stoichiometric (14.7) and put this in the EGO Switch Point and ensure you select Wide Band rather than Narrow Band!#

Ignition Tuning:

Before tuning the spark table ensure the **Trigger Angle** has been checked and set using a timing strobe, this is more important than I can stress, so please do it!!

Tuning the **spark map** may not seem the easiest thing in the world to do and it can be difficult to know where to start. Here is a base map that is for a Boosted engine (>100KPa = Boost)



Spark Map Tuning Basics - The idea is that the idle and low speed area's are retarded to around 8-20deg, usually idle will be around 8-12deg, but this depends on your engine's design. If you set the first row in the RPM range as a little under your usual idle (e.g.600 if your engine idles at 800ish) and add some advance here, so if the engine stumbles into this area the slight increase in advance will help it to speed up a little so it doesn't stall. The cruising area of the map should have a reasonably high advance, (low to high 30's) as the mixture will be reasonably lean and therefore will give a slower burn. The overrun area can have an even greater advance, this will allow you to run lean in that section. At Wide Open Throttle (WOT) the spark map needs to be RPM based (analogous to centrifugal advance on an old style distributor) coming in at the right rate relative to engine RPM. Typically, you want it "all in" by about 2800-3200 RPMs for a street performance motor.

Note the the optimum amount of total advance is not necessarily the most that doesn't cause detonation. For example, with a modern cylinder head design, you might get maximum power at 32°BTDC, but might not experience any detonation until 38°- 40°. However you will still want the advance to come in as quickly as possible (without knocking) up to 32°. For example, my 5.0L Rover based V8 produces max power around 28 - 30°BTDC at WOT, but even at 36° at WOT, I have no detectable detonation. As the Kpa increases (load increase) the spark map should retard as the mixture will be richer and the chances of detonation will also increase with the load. When going into boost the advance table values will need to be lower than when out of boost (>100KPa = boost) and as the boost level increases the advance will need to decrease with it, as detonation is more likely. It has been said that 1deg of advance should be removed for every 2PSI of boost; this is simply a rough guide and lots of things can depend on how much to remove including compression ratio. Detonation Cans are a great option for tuning in boost, use a piece of copper pipe flattened at one end with a flexible tube connected to it. Bolt the flattened end to the cylinder head. Get an old set of ear defenders and drill a hole into the side of them, push the other end or the tube into the hole youve just drilled in the defenders and you should be able to hear any detonation as it occurs.

Crusing is probably the hardest part of the spark map to tune, so this will need several rows set up around that area, see setting the KPa and RPM rows for fuel HERE as it follows the same theory. Shunting in the crusing area is usually down to too much advance, or too weak a mixture. If the mixture is correct (14.7 to 13.5 depending on your cam) then it may be worth removing advance untill the shunting subsides. Too little advance will reduce throttle responce so don't go too far, too little advance can also create higher exhaust gas temperatures. Go back and check the AFR after tuning this area, as the spark angle will effect the AFR readings.

One thing to bear in mind is that altering the spark table WILL effect the AFR. So you will have to re-visit the VE table after tuning the spark table.

If you experience detonation in your engine, then either:

* Your mixture is too lean. Increase the numbers in the VE table at the point the engine detonates (or increase the Req_Fuel if the detonation occurs at all points). Also make sure your fuel pump is operating well. It may be supplying enough fuel at idle, but not supplying enough when the demand rises. Use the oxygen sensor readings to determine if you are lean,
* You have oil leakage into the combustion chamber (check the plugs for signs of oil). This could come past the rings or seals (possibly worn, or from something that was forgotten during assembly, or there are blocked drain back passages in the head, or the rings have been damaged by detonation or over-revving), a 'leaky' PVC system, or from a poor intake manifold gasket seal allowing oil into the runners (on push rod V-engines),
* Your spark advance may come in too far and/or too fast. Edit the spark advance table to lower the rate at which advance is added. You may also need to limit the total advance. Most engines will not require more than ~36° at WOT (possibly more for a flathead design, or a large open chamber, large piston dome design). Newer cylinder head designs and 4 valve/cylinders heads generally don't require a lot of advance,
* You have spark plugs that are too hot (get a range or two colder), or they are incorrectly torqued (if they are loose, they over-heat because of poor thermal contact with the head),
* Your thermostat is too hot (you can try as low as a 160°F thermostat for street use),