

Swingtan's L76 / E38 VVE Dial in Guide

This guide will help with correcting the VVE table in E38 based vehicles when using EFILive. In particular, it deals with the L76 motor as fitted to the VZ Holden range, though can be used for the L98 as fitted the VE Holden range and possibly to all other E38 ECM based vehicles. This document should be read in conjunction with the "Virtual VE Tutorial" provided by EFILive, you should also read through this entire document a couple of times before actually starting any work.

Ensure the car is up to normal operating temp before starting this.

Set-up

Disable Fuel Trims

LTFT

Long Term Fuel Trims will affect the overall AFR of the motor. It will do this automatically, meaning you really don't know what it's getting up to. You need to turn off the trims to correct the VVE table and MAF. You can leave it off for good once this is completed as the LTFT are there to correct the factory VVE settings. The LTFTs are applied to all fuelling settings including Power Enrichment.

Parameter: B1508

Set to 140' (basically anything well over normal running temp.)

Parameter: B1509

Set to any value below any expected temp. IE. -40'

Parameter: B1510

Set all cells to 140kPa. This will prevent LTFT from ever becoming active in a N/A car. If you are running any sort of boost, then you will need to set it above your max boost pressure.

STFT

Short Term Fuel Trims do much the same thing as LTFTs but only average their adjustment over a short period and don't run during PE. Their use can be good once the VVE is dialled in, as they will help correct for things like air temp, pressure, humidity etc. For dialling in though, they need to be off.

Parameter: B1501

Set all cells to max i.e. 65535

Parameter: B1502

Set all cells to 140' (basically anything well over normal running temp.)

Parameter: B1503

Set all cells to max i.e. 65535

Parameter: B1504

Set all cells to 140' (basically anything well over normal running temp.)

Parameter: B1505

No Change

Parameter: B1506

Set to 0.1

Parameter: B1507

Set to max IE. 255

Parameter: B1513

Set to 0

Parameter: B1514

Set to max IE. 1500

These settings should prevent Closed Loop mode in the ECM. This is needed to dial in the VVE and the MAF. To confirm that the ECM remains in Open Loop mode, log "FUELSYS" and under the "data" tab it should remain reading "OL". If it goes into "CL" the ECM will be using the O2 sensors to adjust fuel levels. This is not good at this point.

DFCO

Deceleration Fuel Cut Off will upset the logging process as the AFRs will hit 25:1 when slowing down. It's a good idea to turn them off.

Parameter: B2405

Set to 140' (basically anything well over normal running temp.)

Parameter: B2406

Set to 140' (basically anything well over normal running temp.)

Set Command AFRs

There are 2 thoughts on setting the AFRs for dialling in the VVE and MAF. You can set a fairly rich commanded AFR, to ensure you don't run lean, or you can set a "normal" AFR and keep a close eye on the Wide Band readings. If they start to go lean, get off the power.... The settings here should be fine for a fairly stock car, big cams and FI will need richer settings.

Cruise AFR

I commanded 14.5:1 for cruise. This is marginally richer than Stoich and should work fine. This section relies on the car being up to normal operating temp.

Parameter: B0141

Set all cells to 14.5 (assuming you have EFILive set to work in AFR)

Parameter: B0143

Set all cells to 14.5 (assuming you have EFILive set to work in AFR)

Parameter: B0146

Set all cells over 80' to 1.00

This should command 14.5:1 AFR for all fuelling once the car has entered normal run mode, except for Power Enrichment mode.

Power Enrichment

I commanded 12.5:1 for PE mode to ensure I didn't run lean. You will also want to control PE a little better than stock. I run the TPS settings very low and use MAP kPA to control PE. This has worked very well for me.

Parameter: B0156

Set all cells to 4.0% (note that there appears to be an offset in the TPS settings in the tune compared to measured TPS in Scan Tool. 4% in the tune is about 30% - 35% in real life)

Parameter: B0157

Set to 75kPA

Parameter: B0161

Set to 0.5 % (note that there appears to be an offset in the TPS settings in the tune compared to measured TPS in Scan Tool. 0.5 in the tune is about 10% - 15% in real life)

Parameter: B0169

Set to 0.1 to ramp in the fuel quickly. This will help when taking readings.

Parameter: B0170

Set to 0.1 to ramp out the fuel quickly. This will help when taking readings

Parameter: B3618

Set all cells to 12.5:1 AFR

Parameter: B0804

Set to "No" to turn off Cat Protection Enrichment.

These settings should fix the commanded AFRs to either 14.5:1 or 12.5:1. This will make reading the off sets easier later on. Turn off any other settings that may affect AFRs while testing.

Disable the MAF

First step needed is to disable the MAF and only run on the VE table.

Parameter: C0301 & C0302

Swap the values for these to calibrations,

- C0301 = 10
- C0302 = 13500 (or whatever C0301 was)

Note that this should work OK, providing your MAF hasn't actually failed. If your MAF has failed, it may "enable" the MAF calculations.

Parameter: C0303 & C0305

Set to "10"

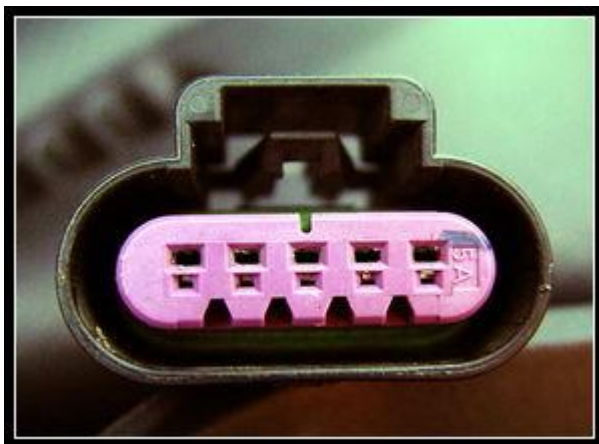
Parameter: P0101, P0102 and P0103

Set all to "No MIL"

These settings will need to be "undone" if the MAF is going to be used again.

Finally, you may need to either unplug the MAF and rig up a separate IAT sensor, or remove the "YELLOW" wire from the MAF plug and replace the plug. Removing the signal wire from the MAF is very easy to do and can be restored in very little time. If your ECM simply won't fail the MAF in the tune, this is your other option.

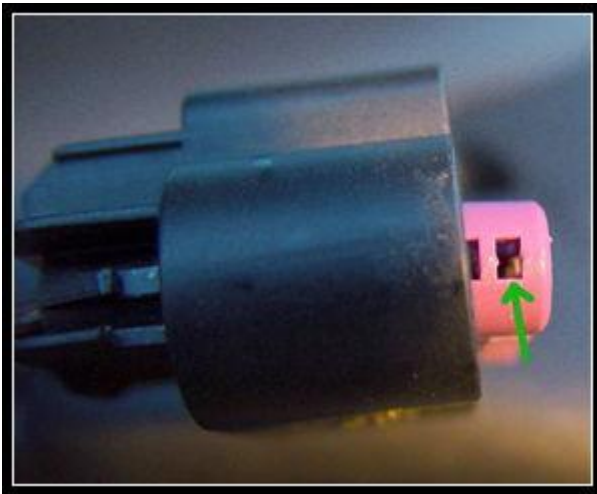
1. Unplug the MAF and look at the plug. It has a "pink / purple" centre section covering the contacts inside and on the rear, has the same colour retainer for the wires. Both need to come off, note now how they fit so you get it right when it comes time to replace them.



2. Starting with the rear retainer, lift the end of the locking tab up with a small screw driver and prise the retainer back, away from the plug. Do this on both sides to free the retainer.



- Turning the plug around, use the small screwdriver to prise out the inner contact cover. There are small holes in the side of the cover that will help. With the inner cover removed, you can now see the connector pin locking tabs.



- Take hold of the "Yellow" wire at the back of the plug and gently push forwards in it. Then using the small screwdriver, release the pressure on the locking pin and carefully draw the pin back out of the rear of the plug. The first picture below shows the locking tab that locks the connector in place. Once the wire is removed, tape it back against the rest of the loom to keep it out of the way.



- Now just replace the 2 plastic covers to their original positions and plug the MAF back in. Confirm you have a valid IAT reading and that the MAF frequency is "0"

To return the MAF to normal operation, just put the pin back in. Note which way it fits and gently pull on the yellow wire to ensure it has locked into position.

Logging

Set Up PIDS

The minimum PIDs required are as follows....

- Commanded AFR
- WB O2 AFR
- IAT
- MAP
- Engine RPM
- BEN Factor for your WB sensor

This should give you all the data you need to adjust the VVE.

BIG NOTE: The process of adjusting the VVE is not the same as for the LS1 VE table. You may be able to get the "Auto VE" process working to some degree, but in the end I didn't use it. I found it simply didn't adjust the cells in a way that worked well. It will take multiple goes to get the VVE pretty close.

Before actually driving the car, you should read the note on the next page.

Once the PIDs are set up. Go driving or test it on the dyno. This part is much the same as the LS1 Auto VE process, in that you want to run the engine at as many load points as possible to get sufficient data. Slow pedal movements help a lot and try and keep a single throttle position as long as possible. Get as much data as possible. It will help to use the E38 BEN MAP (Virtual VE Table – WB BEN.map) to see what cells need to be hit. This map can also be used to help adjust the VVE later on.

Adjusting

IAT Compensation

The first step is to ensure steady AFR readings across a range of Intake Air Temp (IAT) readings. Not doing this means you run the risk of changes in IAT effecting the final AFR's. You could end up chasing your tail and not getting the results you expected. So to adjust the resultant AFR's for IAT, warm the car up with a decent drive, but don't get caught in traffic which may cause "heat soak". You want the engine hot, but the intake cool to start with. Then find a place you can park for a while with the engine idling.

Ensure you are logging IAT and WB AFR as a minimum for this step. Start the logging while driving and let the log continue while the car is stationary. What you are trying to do is heat soak the intake to push the IAT as high as you can. I let mine go to 75°C, as I've seen it get that high in traffic on a hot day. Once the IAT has reached it's hottest point or something around 75°C, you can stop the log and turn the car off (or drive home).

Open the log in ScanTool and make sure you have both IAT and WB AFR displayed. Expand the log so you can clearly see the changes in IAT as it warms up. It may be worth plotting IAT and WB AFR on the one chart, and then maximising that chart so it's easier to work with. You should end up with something like this.



Note that the IAT in this example only goes to 45°C but already you can see a large drift in the WB AFR. You are now ready to start correcting this drift.

Parameter: B1213

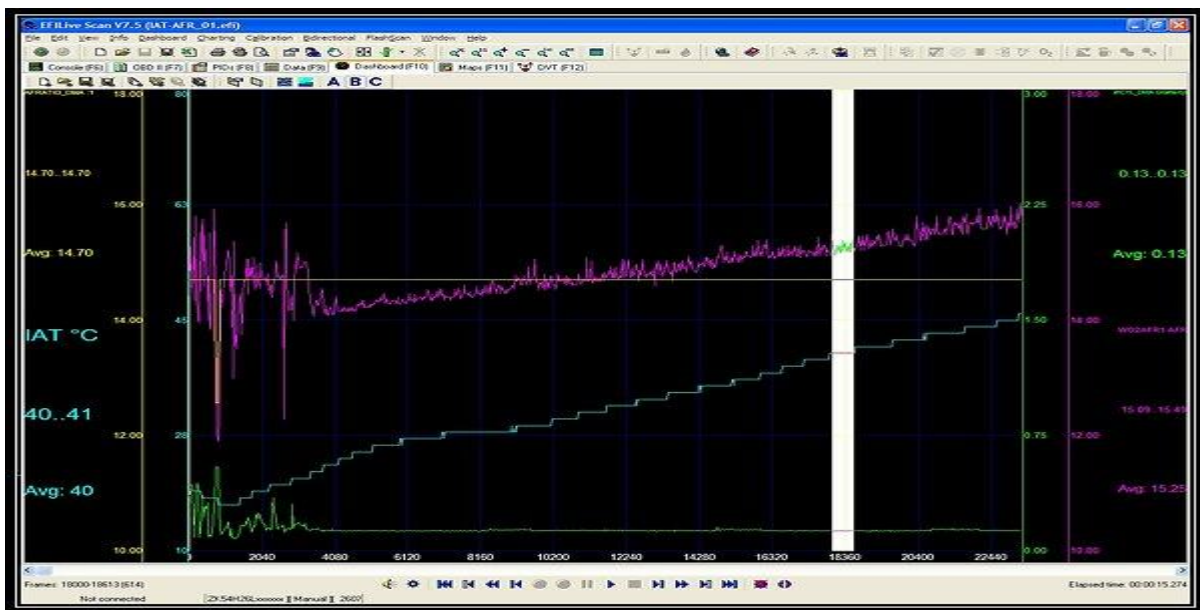
The default values in this table are useably all "1" and provide no compensation for IAT. This table is a "flow modifier factor" for the Injectors, so larger numbers here make the ECM believe the injectors flow more. Smaller numbers make it think the injectors flow less. In the case of the log above we want to richen up the mixture as IAT rises, so we tell the ECM that the injectors flow "LESS". The ECM then commands more fuel to compensate for the lower flow rate.

Pick an arbitrary temperature to be the “default” or reference temperature. This should probably be a “typical average” of the normal ambient temp, I chose 25°C as I can expect ambient temps between 0°C and 45°C where I live. So keeping the factor at “1” for 25°C we need to adjust above and below this temp to get a steady WB AFR reading.
 B1213 progresses in 10°C steps from -40°C to 120°C so we need to use these values to do the correction. The easiest way I found was to highlight the section of the log where the IAT remained constant, and then read the averaged WB AFR value. Divide the commanded AFR value by the averaged value to give a correction factor.

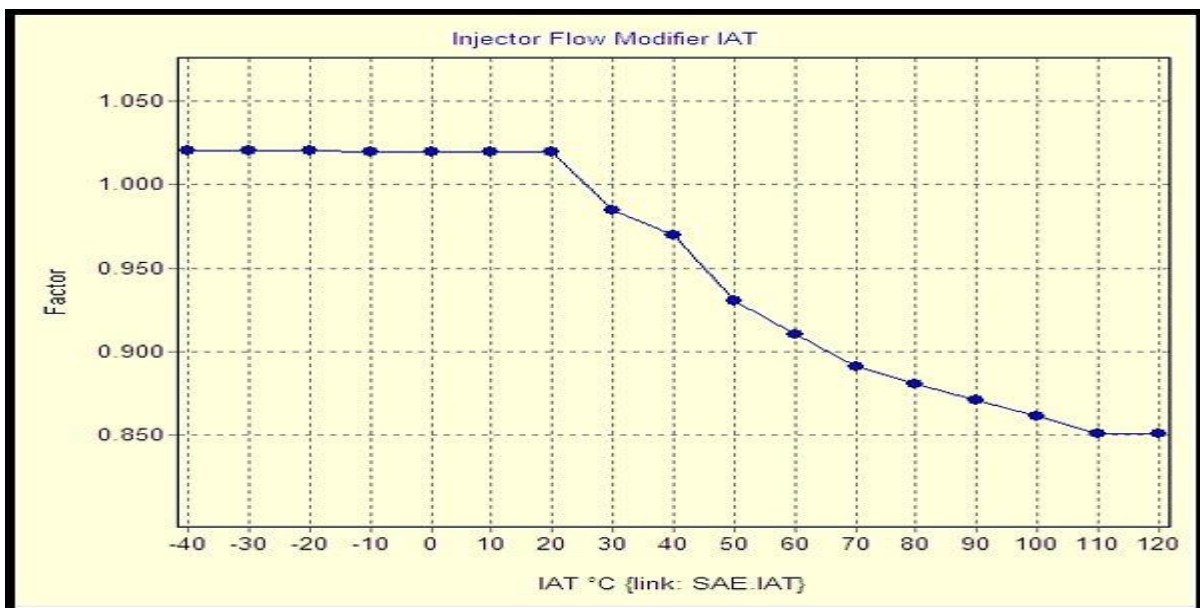
In the example below, I've highlighted where IAT=40°C and the average WB AFR is 15.25. Calculating the correction factor gives...

$$14.7 / 15.25 = 0.964$$

So this is entered into the 40°C cell in **B1213**. Continue this for each cell in **B1213**



When you have gone through all the data, you should end up with a table that looks something like this.



You may need to go through a couple of cycles to get a really steady reading on the WB, but it should only take a couple of goes. Another point is that you may need to “guestimate” the correction factors for IAT temps that you can’t measure. For example if it’s summer and the minimum temps are much higher than

winter temps. Just make an educated guess, working on the data you have. In the end you should be able to get a nice flat WB AFR reading no matter what the IAT reading is.



NOTE: the oscillating WB AFR reading is actually the engine cooling fans switching on and off

In the example above, the average for all the WB data from an IAT of 40°C to 72°C is 14.75:1. This will help keep the AFR's steady under differing conditions when gathering data for the VVE modifications.

VVE

To make adjustments to the VVE, you need to start the Tune Tool with the V2 plugged into the laptop / computer. This will enable some additional features, not normally available. The additional settings are highlighted in red and will be easily visible.

Parameter: B8020

The stock settings here seems to assume that the MAF will work for all RPM ranges over 3000 RPM. This won't work when the MAF is turned off. Reset these boundaries to something that gives you a series of more sensible zones for your expected RPM range. Look at where you would normally be driving and set the zones accordingly. Something like 2000, 3500, 4500, 5500 RPM may work well. This table has a big effect on the VVE shape.

Parameter: B8021

As with the previous setting, this helps to shape the VVE table. Adjusting the setting to make the zone match expected driving conditions will help a lot. The stock settings are pretty good, but you may want to drop the "MAP 1" values to help set the idle airflow.

NOTE: At this point, ensure that the "UNITS" set up for B8021 match with B8001. In other words, make sure both tables are using kPa or PSI. Mixing these up will result in the VVE zone boundaries not being where you expect them to be.

Before moving on, you should do 3 things...

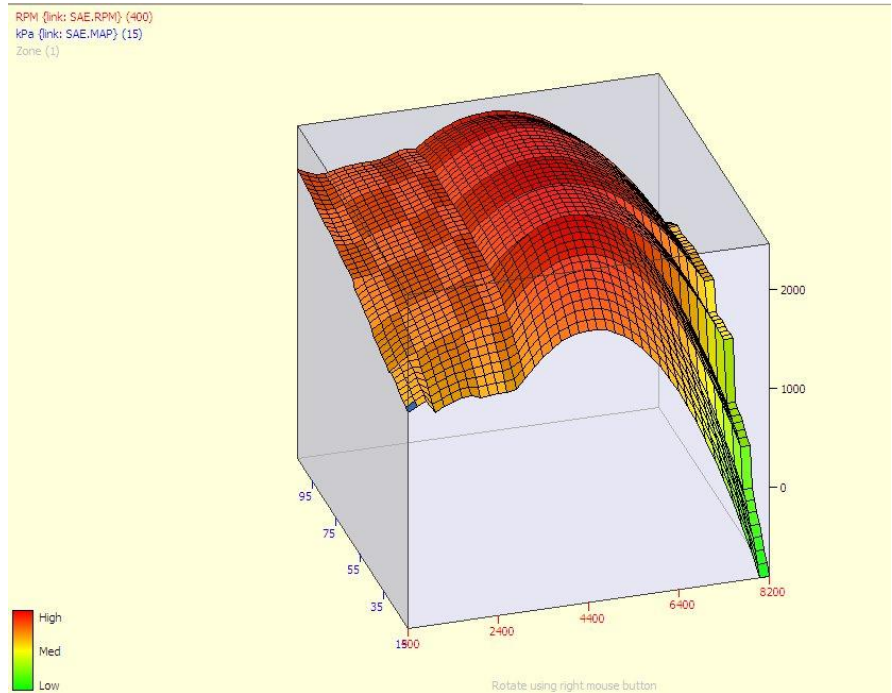
1. Go to B8101, press <F4>, select all cells and "copy with labels"
2. Save the current tune (after adjusting the previous 2 parameters) as a new tune file.
3. "Re-open" the same file, and go to B8101. It should look somewhat different to previously if you have changed the previous parameters. Select all cells and "Paste with labels" to return the VVE to a stock like map. Click on "Generate Coeffs" and "Generate VVE" to complete the process.

To be honest, you really should do this part before logging, as it will change the VVE settings a little bit.

You should now be ready to start adjusting the VVE.

Parameter: B8101

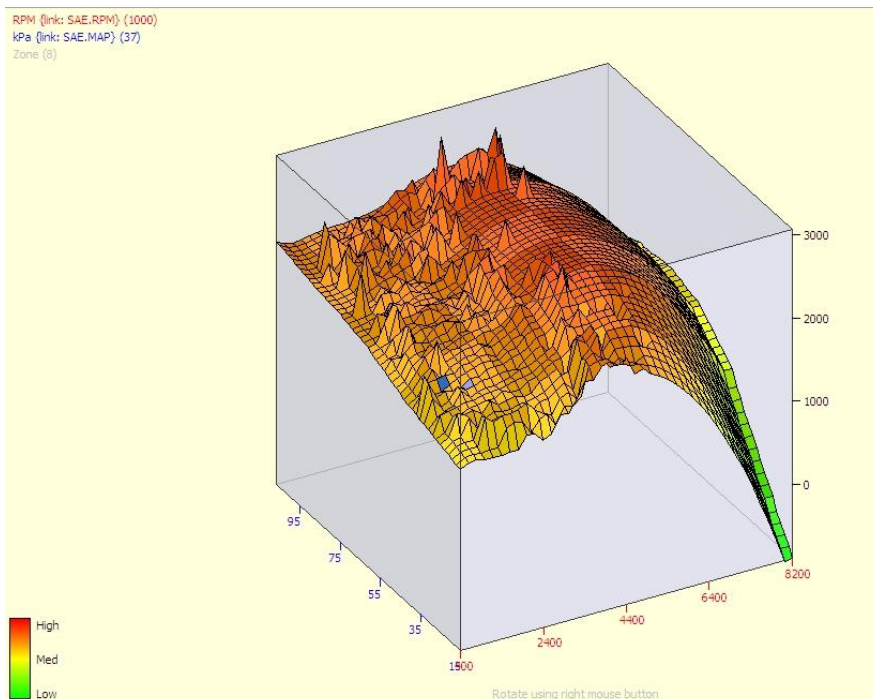
This table sets all of the VVE up for N/A vehicles. As with the EFILive notes, look at how the graph has the shaded squares. These squares are the zones set up in the previous parameters. The important thing to remember, is that any one zone can only have a single curve in any direction. You can make a “dome” or a “hollow” in a cell, but not a “wave”. This is why it's important to get the zones right.



The stock L76 VVE

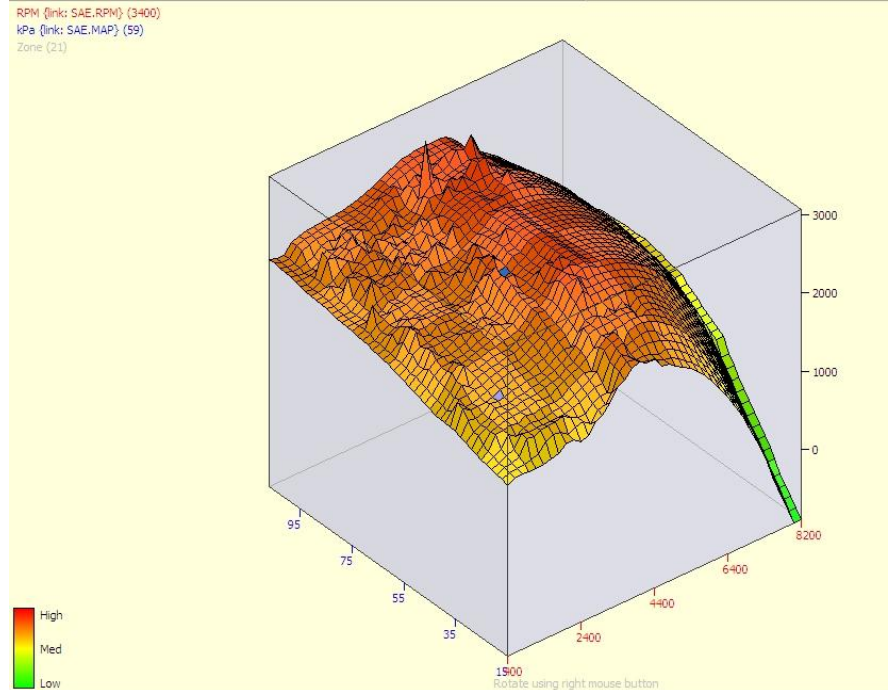
You can apply the figures from the BEN map as for the LS1 Auto VE process, but the generation of the Coeffs. Will have a smoothing effect on the changes. Trying the old trick of applying twice and smoothing didn't work too well either, so it became a more manual process to get things right.

- Apply the BEN map (copy the required BEN cells with labels, then “apply with labels and multiply” on the VVE). This will give a fairly spiky looking map.



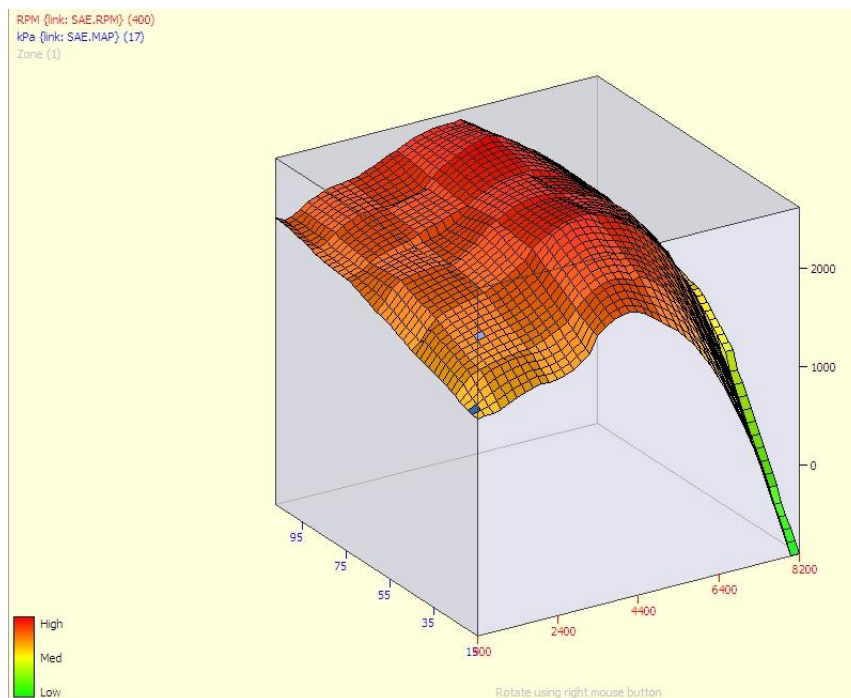
BENs Applied To VVE

- Next work on the areas where the spikes go up. In the “adjust” field at the top of the page, enter a figure of say 4. Then select the cells around the spikes, and click the “%” button to add 4% to the VVE values. Move around the spikes to “even” them up a bit.
- Then add a “-“ in front of the 4 and work around the dips.
- When adjusting cells, remember that if there is a change next to a “zone” boundary, you need to extend that change into the next zone. This will help to get the shape you need.



VVE After Manual Smoothing

- When this is done, click on “Generate Coeffs” and “Generate VVE” to see the difference you made. Note how much smoothing has gone on. If for some reason something looks way out, you can not “undo”. If it’s not too bad, you may be able to adjust it and re-generate. If the MAP is too bad, you will need to revert the tune and start again. The final map should be fairly smooth, though it will have some steps in it here and there. As long as they are not too big, it should be fine.

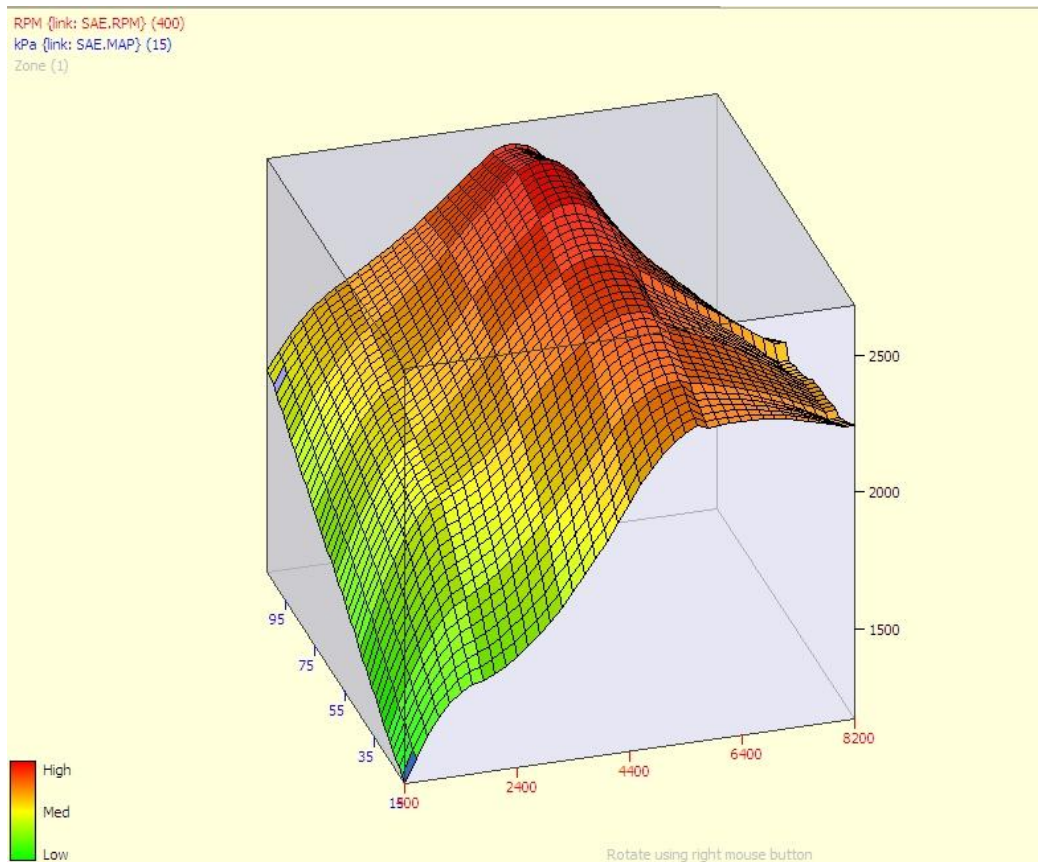


VVE After Generation Of Coeffs and Generation of VVE

A tip here is that you may need to make adjustments to cells well over your normal RPM range, to allow you to get the right settings around peak RPM. Just work slowly and try to

only generate the Coeffs and VVE once per session. Multiple generations will tend to smooth the entire table, flattening it out.

Once you are finished, go testing again and then come back to re-adjust the VVE. This time though, when doing the manual adjustments, drop the setting to say "2%". As you keep going you may want to drop to 1%. After multiple runs, the VVE should start looking like this...



Modified VVE

You may find that the generation of the VVE applies too much smoothing in some areas, causing a shift in AFRs away for the commanded levels. This may be seen around the normal idle settings and cause an overly rich or lean idle. To fix these areas up you may need to manually over adjust these areas then allow the VVE generation to bring these cells back to the correct area.

At the same time, it's a good idea to alter the areas of the VVE above your normal RPM range to more suitable values. While your motor may never see 6500+ RPM, the shape of the VVE past here still influences the overall shape. The smaller the change in the VVE cells, the more accurate the VVE becomes. The stock VVE has negative values in the high RPM / low MAP area, these should be manually altered to flatten the top region of the VVE graph as shown above.

This is pretty much all there is to doing the VVE. Remember to save each adjustment of the VVE as a new file, so if something change too much, you can revert back to the last known good version.

If you want to stay running full Speed Density, you can re-enable DFCO and that's about it. To run a plain MAFless tune, re-enable the O2's and STFT. Also don't forget to reset your AFRs. If you want to go back to the MAF, continue on

Notes On Forced Induction

1. The adjustments above are primarily for Normally Aspirated (NA) motors, though will be useful for Forced Induction as well. You should note that the table in B8101 peaks at a MAP setting of 105kPA, about the maximum you could expect from a NA engine (the highest I've measured is 103kPA with the car running). For FI, you will need to work out how much boost you will run and after setting the tune up for that, adjustments are made to the appropriate table. For a 2 bar tune, use B8103, this will allow MAP pressure up to 201kPA, for a 3 bar tune, use B8105, which allows a peak MAP pressure of 255kPA.

The adjustment process is much the same but you will need to set appropriate AFR's for boost. PE settings in the 10:1 range are probably a good start here.

2. Steve from Oztracktuning has the following tip.
"Also a tip for Forced induction people, beware of a weird effect of burst knock activation mid acceleration not just at throttle tip in."

MAF Adjustment

To dial in the MAF, first re-enable it by reversing the steps above. Then select at least the following PIDs for logging...

MAFFREQ2
APCYL_DMA
MAF
AFR
WB O2 AFR

Follow the same process for logging as for the VVE, you can use the BEN map to try and hit as many cells as possible. While a new MAP could be made up with a new BEN for the MAF, I found it was just as easy to look at the Dash page and see where the WB AFR differs from the commanded AFR. Then you just adjust the MAF settings to correct for any drift. The stock MAF is very close though and only small adjustments should be needed.

For the L76, adjustments are in 2 tables

Parameter: B1097

For MAF frequencies from 1000Hz to 5800Hz

Parameter: B1098

For MAF frequencies from 5800Hz to 12200Hz

For the L98 there is only one table for the lot.

Parameter: B1097

For MAF frequencies from 0Hz to 15000Hz

Once you are happy with the MAF settings, re-enable the O2s, STFTs and DFCO.

These adjustments should show a huge improvement in mid range torque and throttle response.

Credits

Thanks to the following people for helping with this document.

- Jezza
- Hymey
- vxleather
- alian
- SirNemesis