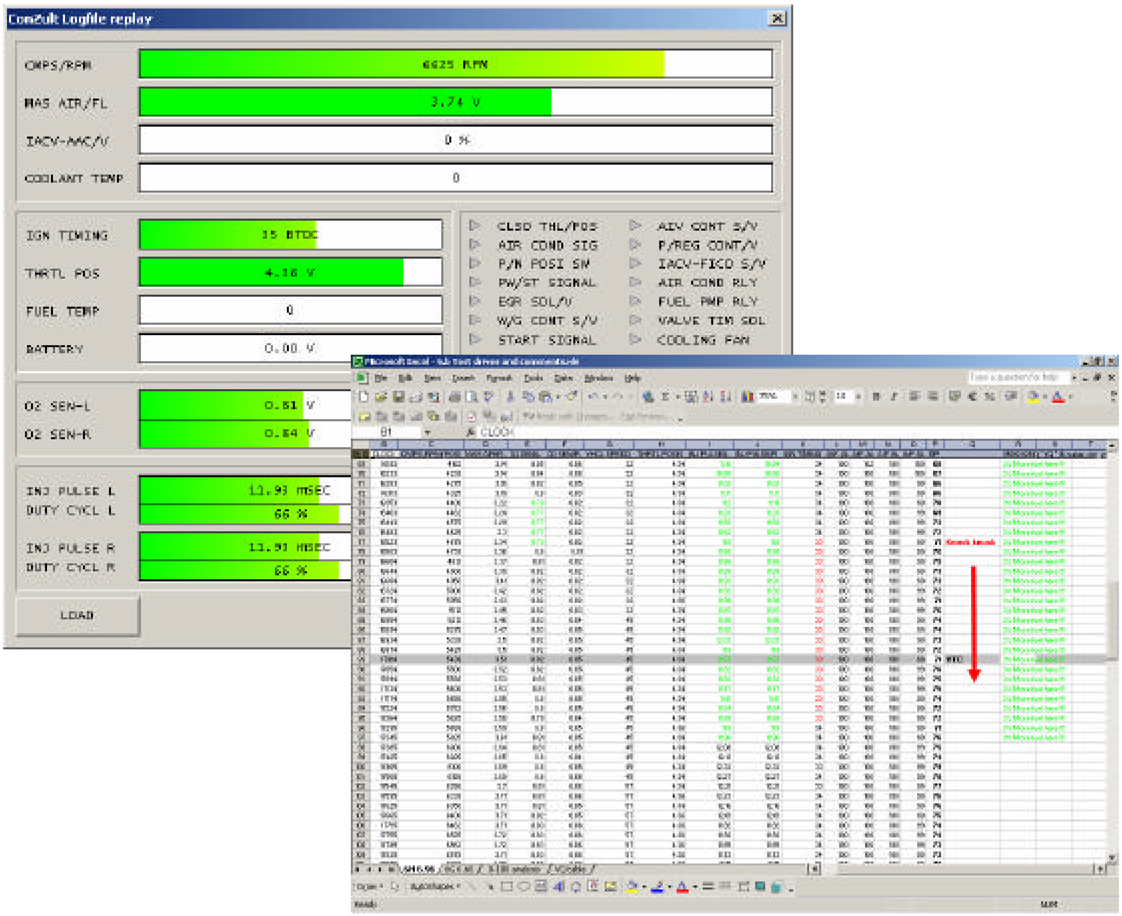

Tuning Z32 (or PS13 & S14) ECU, part II
Street tuning with DTA ConZult

Contents

Foreword

In this Z32 ECU tuning part II document, I outline the basics of how an engine sensor logging software like DTA ConZult, ConSXult and other packages can be used for ECU tuning to improve street acceleration. In Z32 ECU tuning, part I the basics of ECU tuning was outlined. That document was written in Finnish and contains basically the same information as Devin has written at www.ztechz.net . Part II is written in English to share my own experiences of making a 300ZX NA faster with a wider audience.

For me, sell your NA and buy a TT is an answer that is repeated like a mantra – maybe because no real information about NA tuning is available. Of course I am too considering slapping in turbos or doing TT engine swap for more power - but as I am already getting too much wheel spin when overtaking on rainy days not to mention our icy winter roads - I am more tempted putting my focus to the car I already have. The 300ZX NA is not an 400rwhp or 800bhp monster that some of the TT:s are – but as I have learned, a Stage II NA can be made about as fast on street as a stock TT for much less than €1000 or $1000 – with very little effort.
(0-100km/h acceleration times: Stock 300ZXTT Auto: 6.5s, my Stage II 300ZX NA Auto: consistent 6.5s on street)

Most of this text is by nature very generic and can be applied to tune Z32 TT:s or other Nissan models including PS13 & S14– just remember to read the disclaimer before you start.

Have fun and keep me posted if you find anything you would like to comment, add or ask.

August, 2003

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Ps. English is not my first language, so if you have suggestions in making the text more easily readable and understandable - drop me an email.

Copyright and disclaimer

Disclaimer: Regardless of a lot personal research and work put on this topic, the information presented is mainly based on assumptions which seem to work. Hence **no guarantee about accuracy of this information can be given.** This is like many other documents in internet, just personal experiences. **Trying and/or implementing anything described here is at your own risk.**

Acknowledgements

I have spent countless hours in internet and reading several books about ECU tuning to be in a position to start making improvements rather than loosing power with tuning my Z32 engine. Out of the numerous sources there are some that I would like to honor by naming them in helping me to reach this point.

Above everyone else raises **Ashley Powers** with his write-ups in www.twinturbo.net. He is probably the most valuable asset that the Z32 community currently has with his Zemulator project and several other hardware development projects like doing a complete NA to TT conversion. If you ever decide upon e.g. buying an ECU upgrade or professional ECU programming tool go for his products like Zemulator (at beta when writing this).

Devin Novak is the person who we all can thank for making the Z32 ECU map information publicly available. His write-up about the ECU in www.ztechz.net opened the jackpot in generating understanding of what and how to adjust ECU parameters.

John Dixon is the man who has made modifying EPROMS very easy with his infamous excel tool, without his valuable efforts we could still be living EPROM tuning stone age with hex editors.

Pascal Higelin has helped by offering the most comprehensive insight of how Z32 ECU works and particularly getting the TP constants and 2d interpolation correct. He also has given valuable feedback to details and theoretical side of this document, although I have not implemented all of his feedback to keep the basic concepts as simple as possible.

For making the ECU logging available we must also thank **DTA-Motorsports** for putting the effort in reverse engineering the Consult DLL protocols and writing ConZult software. I believe that now that Z32 community can start to use ConZult for tuning we can soon start to see 200SX drivers to join us by using ConSXult.

Improving 300ZX acceleration times

Owning a 300ZX makes you feel that you have a fast car by just looks of it. When I first time recorded my 1994 2+2 NA Auto acceleration time with and Apexi RSM, I was very disappointed to the performance. The blue screen showed a lengthy 7.46s for 0-100km/h. At that point I already had installed JWT POP, ASP UDP and AshZ ECU. Being an inexperienced drag driver I knew the high number was partially because of the driver, but I also felt that the full potential of the car was not yet reached - so I started systematically to research areas to improve the acceleration times.

This study revealed that in my case there really are really only three major areas to consider in making the car faster:

1. Better utilizing the power bands by optimizing the use of auto tranny
2. Minimizing power losses
3. Making more power out of the engine

At the time of writing this I am now running 6.5s times at NA Stage II with just POP, UDP, ECU + some tweaks– almost a second faster than before I started. The first third of that was achieved with above mentioned bolt on upgrades like POP, UDP, ECU and some tweaks. Another third was achieved by working out the shifting points and learning a proper launch technique. The last third was achieved by fine tuning the ECU maps to better utilize the bolt on upgrades.

In this document we are mainly concerning on making more power out of the engine by fine-tuning the information inside ECU, but at the end of this document there is a chapter describing launch techniques, bolt on upgrades and tweaks.

ECU Street tuning tools

An aftermarket ECU with a decently tuned map like AshSpec or JWT ECU is a very good starting point for a street tuner. It already has the timing and fuel optimized for the engine set up making the amount of work needed much smaller than starting from the stock ECU. The added benefit of having an aftermarket ECU as a starting point is that then it already has the socket installed.

Although tuned for power, usually the aftermarket ECU's are optimized for a particular car in particular environment and then made generic by adding safety and reducing the gains. Depending on the country you live, you may be able to push the limits to gain more power with e.g. higher octane fuel available for you. As each car is a unique combination of modifications, to max out the power gains, you really need to have an ECU that is particularly tuned for your modified car and fuel.

When starting with ECU tuning it is good to bear in mind that the tuner can have two distinctive goals: either to maximize the top power output on a dyno environment or improve the acceleration times on a track or street. Personally I do not care how much theoretical power my car is making in dyno environment, for me it's the street acceleration that counts.

For ECU street tuning one really needs only a handful of tools. It is easy to change the different parameters inside ECU, but the most difficult part is to know what to change and why. DTA-Motorsports in Netherlands has developed an engine sensor logging product consisting a hardware module connecting to the Consult DLL port using a PC or laptop. ConZult is a very much overlooked product by many engine tuners - maybe partly because not much of information about its full data log capability for engine tuning has not been widely available before this.

If you are reading this document I assume that you are familiar with the basic concepts of chip tuning and Z32 engine, but to refresh your memory of what is needed, here is a list:

- ConZult data logging tool from www.DTA-motorsport.com
- Z32 chip programming Excel by John Dixon from www.ztechz.net

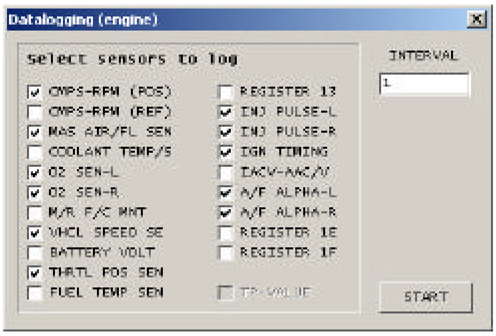
- An EPROM burner or emulator like outlined on the ECU programming section of www.ztechz.net by Devin Novak (or access to someone who can burn the EPROM's for you)
- Apexi RSM or another meter which can measure 0-100kmh and 0-400m times for you to actually measure the gains
- A sample excel file how TP calculation and log file runs are done (developed myself available from www.ztechz.net)

To start with you also need to read the ConZult manual, ConZult Excel data logging manual and the www.ztechz.net ECU programming section - and above all you need to **read the disclaimer in the beginning of this document.**

In addition to the above tools I also use a microphone connected to my laptop to record the sounds of an odd run. This helps me to hear any knocking / detonation at high rpm when the ECU's knock detection is disabled. If nothing else, it is quite fascinating experience to hear first the intake sounds soon being overtaken the exhaust sounds when the RPM is starting to go up.

ConZult data logging facility

The ConZult data logging feature allows the user to log e.g. a 0-400 run and then play that back by millisecond after millisecond. It makes the user to literally see what happens inside the engine bay the by monitoring e.g. the air delivery, fuel delivery, A/F mixture and ignition advance. From an engine tuners perspective the list most interesting sensors to log are the following:



1. engine rpm
2. O2 sensor information
3. MAF sensor
4. Ignition advance
5. Injector pulse width
6. self learn and enrichment tables

What ConZult does is generates a file, usually called ENGINELOG.TXT containing all of this information for your run.

As the engine literally is an air pump, power can only be made by maximizing the amount of air going in. From tuning perspective the most important sensor is MAF sensor, the higher figures you get the more the engine is taking air in. The rest is just tweaking the ignition and A/F maps to optimize how well you use that air.

By reading the engine log with sensor values, it's easy to detect if the engine was running in closed loop, if a knock occurred retarding timing or if the A/F was not correct for a particular part of the run. Also by playing back this information the user can see exactly how the run mapped to the ECU ignition and fuel tables. The engine log information can be used to pinpoint which part of the map the ECU was using at a particular moment by using RPM and calculated TP figures for corresponding axis on the fuel and ignition maps.

The enginelog.txt file needs to be loaded in excel before it can fully be utilized in engine tuning. With ConZult you get instructions how to read a log file to excel.

Reading and understanding the ConZult log file

Reading the ConZult engine log information may look difficult in the first place, but after highlighting important events with colors make it much more readable. Soon it becomes an invaluable tool to significantly improve 0-100km/h or 0-400 times.

A typical run with automatic gearbox has the following phases (manual riders adjust accordingly) which can be read from the log file.

1. Power braking
2. Start
3. Run events
4. VTC release points
5. Gear change
6. Reaching the speed
7. End run

A good starting point is to find each of these phases and highlight them with a color. When doing that you probably also soon start to notice other things that happened during the run. It is also good practice to add comments to what you find. After some colors and comments log file becomes much more readable and you can start making assumptions for the areas of improvement. Below you find a short description of each of the areas I am focusing on when I am reading the data log files.

THRTL POS/S	INJ PULSE/L	INJ PULSE/R	IGN TIMING	A/F-AL	A/F-AL	A/F AL	A/F AL	TP		[[50/2]/256] * VQ * [K-va
4.34	11.16	10.94	34	100	102	100	100	68		3% More fuel here !!!
4.34	10.86	10.86	34	100	100	100	100	67		3% More fuel here !!!
4.34	11.02	11.02	34	100	100	100	99	66		3% More fuel here !!!
4.34	11.11	11.11	34	100	100	100	99	66		3% More fuel here !!!
4.34	11.2	11.18	34	100	100	100	99	70		3% More fuel here !!!
4.34	11.28	11.28	34	100	100	100	99	69		3% More fuel here !!!
4.34	11.58	11.58	34	100	100	100	99	73		3% More fuel here !!!
4.34	11.62	11.62	34	100	100	100	99	72		3% More fuel here !!!
4.34	11.8	11.8	33	100	100	100	99	71	Knock knock	3% More fuel here !!!
4.34	11.86	11.86	33	100	100	100	99	76		3% More fuel here !!!
4.34	11.86	11.86	33	100	100	100	99	75		3% More fuel here !!!
4.34	11.89	11.89	33	100	100	100	99	73		3% More fuel here !!!
4.34	11.93	11.93	33	100	100	100	99	73		3% More fuel here !!!
4.34	11.92	11.92	33	100	100	100	99	72		3% More fuel here !!!
4.36	11.98	11.98	33	100	100	100	99	71		3% More fuel here !!!
4.34	11.97	11.97	33	100	100	100	99	76		3% More fuel here !!!
4.34	11.95	11.95	33	100	100	100	99	74		3% More fuel here !!!
4.34	11.92	11.92	33	100	100	100	99	74		3% More fuel here !!!
4.34	12.03	12.03	33	100	100	100	99	73		3% More fuel here !!!
4.34	11.9	11.9	33	100	100	100	99	72		3% More fuel here !!!
4.34	11.87	11.87	33	100	100	100	99	71	VTC	3% More fuel here !!!
4.34	11.82	11.82	33	100	100	100	99	76		3% More fuel here !!!
4.34	11.82	11.82	33	100	100	100	99	75		3% More fuel here !!!
4.34	11.77	11.77	33	100	100	100	99	75		3% More fuel here !!!
4.34	11.81	11.81	33	100	100	100	99	74		3% More fuel here !!!
4.34	11.84	11.84	33	100	100	100	99	72		3% More fuel here !!!

Power braking starts when throttle sensor reading increases to just around 1 volt. Be aware that if you power brake on closed loop area the engine may be running lean just after launch – pay particular attention to O2 sensors and enrichment values towards the end of the power braking.

Launch - Run starts when the throttle sensor jumps from around 1 volt to around 4.5 volts. At this point you look at both the O2 sensor readings to notice if engine is running rich or lean. Also take a look at the ignition advance to optimize the advance to generate maximum torque. After launch also look at the enrichment tables and adjust throttle enrichment to increase power with improving A/F ratio by reading the O2 sensors.

Run events During the run pay particular attention to O2 sensor readings and ignition advance. If e.g. ignition log is showing retarded figures when comparing to your ECU maps its likely that the ECU has detected knock. In this case it's also likely that you can, by adding more fuel, reduce the cylinder temperatures and get rid of the knock. (Although adding some fuel when detecting knock seems to be inbuilt feature to the ECU). When the knock retard seems to end as the engine log match the map values, it may be worth while to look the ignition map. This may happen when the knock detection is disabled at higher RPMS. You may also detect that the engine is running lean just after launch, then by moving the engine to open loop earlier or adding fuel to that particular part of the ECU map can help you.

VTC release The RPM when you have programmed the VTC release to happen can be seen from the ECU map. When this happens it also should lead to an immediate increase of the TP figure. You can adjust the VTC release to optimize the MAF voltage output and TP being continuously as high as possible as usually the stock release may happen too late for optimu m torque and power.

Gear change is taking place when the revolutions go down and back up again. The key with this is to notice if the TP figure has been continuously growing until this point. Also the exit RPM and TP load are important to notice. There is a lot to gain by changing the shift points to for better end of gear change and the end of run speeds.

The end speed can be calculated from last gear RPM, at least in the ConZult data file the speedometer figure is not very exact due to the delays in which the speedometer data is read.

The end of the run can be noticed from both RPM and TP sensor readings dropping.

There is much more than the above to reading the log file data and making improvements, but this information should act as a good starting point for the first log file reading sessions.

As you can see this information is really valuable in deciding how to improve the engine performance. After my first ConZult data logging session I burned a new EPROM to improve the fuel curve and tweaked the timing just a bit. The result was an amazing 0.26s improvement on 0-100km/h acceleration time just making assumptions based on the engine log data provided by ConZult.

TP calc - understanding the load calculation

Nissan engineers developed an ECU that is fairly easy to tune to speed up development of different engine setups for different cars. In principle the same ECU is used across a range of different Nissan vehicles. This wide use is made possible by being able to adjust the constant, K-value sometimes together with and fuel, ignition and other of the above 80 maps inside the EPROM.

TP, the theoretical pulse width, when multiplied with K-value defines the amount of fuel that the engine needs for a particular load - bearing in mind the Volumetric Efficiency of an engine. In defining how effective the engine is, the TP figure seems to highly correlate with horsepower potential when correct A/F mixture is used. Hence the TP figure is maybe the most important value for street tuner from two aspects:

1) It defines the place on the vertical axis on the fuel and ignition map axis at a particular moment
2) Although only a rough indicator of the engine power, the higher the TP number is the more power the engine seems to be producing at a particular moment

The TP load of an engine can be calculated based on the engine RPM/CAS and MAF sensor information with the following formula:

TP = Adj1 * K * VQ / RPM + Adj2

Although this formula does not take into account e.g. A/F changes due to co-efficient applied under certain engine conditions, it usually gives precise enough information for engine tuning purposes.

For any chip tuning purposes there are two ways of defining the Adj1 and Adj2:

1) Either the formula is well known for a particular engine. In our case there are several variables affecting the formula. Although it's well known it's also difficult to implement to have precise information. The exact TP formula within Z32 ECU is the following: TP = (VQ+121) * (K)* 8) / ((RPM/12.5) * 256)) * 0.125, anyhow in getting e.g. RPM input to this formula the history needs to be included in the calculation, same applies also to interpreting VQ tables and inputting VQ into this formula. As there is always a mismatch between ECU timing and any data logging software timing, getting an exact match is very difficult...

…or…

2) The user can use known figures from different load figures to extrapolate a the constants Adj1 & Adj2 using known ignition and injector pulses as reference points to make the TP to match to the map.

In many cases the latter method is recommended as the formula does not need to be fully implemented to enable map tracing. Its also good practices to double check that the ECU is not e.g. running in knock timing maps.

As both the basic formula and RPM are known from the ConZult or other data logging tool files, it is very easy for the user to find the TP. This happens by inputting different Adj1 and Adj2 values until the logged ignition advance and injector opening times matches to the ECU maps. Anyhow I hope that when more users are making their engine log files and ECU maps publicly available we can reverse engineer those figures and build a formula to skip to follow the process outlined in the next chapter completely.

(Note: Adj1 and Adj2 are not constants when ECU is running, but for the purpose outlined in this document we can make those constants)

Finding the right constants for TP calculation formula for your ECU

After loading the engine log information into excel it is time to copy the primary fuel and ignition maps into the excel too under a separate worksheet. On a sample excel loadable at www.ztechz.net I have provided a sample file that calculates the TP figures using the above introduced TP calc formula. But as this formula is reverse engineered based on ConZult run data I can not guarantee that it is exactly the same as inside your ECU. Therefore I recommended that you adjust the constants and double check these calculations with the following steps.`

a) Find a suitable row with e.g. 2000 RPM:s and look what the timing advance for that row has been. Then look at the primary timing map and see at which TP figure that timing advance has occurred. If there are too many alike timing advance numbers pick a different RPM.
b) After a relatively unique Timing advance is found, start inputting varying Adj1 and Adj2 values until the formula calculates the same TP load. Now check if other rows with different RPM:s and calculated TP loads have same timing advance on the map as on the log file.
c) Continue adjusting Adj1 and Adj2 by checking the advance until you get the closest pair of matches for the whole run.

CMPS-RPM(POS)	MAS AIR/FL	O2 SEN/L	O2 SEN/R	VHCL S	THRTL I	INJ PULSE/L	INJ PULSE/R	**IGN TIMING**	A/F-AL	A/F-AL	A/F AL	A/F AL	**TP**
700	1.14	0.82	0.83	0	0.48	3.25	3.33	**20**	109	118	109	122	**15**
712	1.14	0.82	0.83	0	0.48	3.27	3.33	**20**	109	118	109	122	**15**
688	1.15	0.82	0.83	0	0.48	3.29	3.37	**20**	109	118	109	122	**15**
712	1.16	0.82	0.83	0	0.5	2.95	2.95	**20**	109	100	109	100	**15**
688	1.31	0.82	0.83	0	0.66	3.65	3.41	**19**	109	100	109	100	**23**
712	1.59	0.82	0.83	0	0.82	4.55	4.51	**19**	109	100	109	100	**37**
700	1.86	0.82	0.83	0	0.96	7.65	7.65	**18**	109	100	109	100	**70**
750	2.06	0.83	0.84	0	1.04	10.57	10.59	**9**	109	100	109	100	**85**
762	2.15	0.83	0.84	0	1.12	14.19	14.23	**5**	109	100	99	100	**95**
875	2.12	0.83	0.82	0	1.14	15.43	15.47	**5**	98	100	99	100	**82**
988	2.06	0.83	0.83	0	1.14	15.45	15.49	**5**	98	100	99	100	**65**

If there is slight difference - bear in mind that ECU uses an 2D interpolation over 4 neighbouring map points and that the VLOOKUP function that searches the VQ table generates a small error. Also it is possible that the engine is running in knock timing map showing significantly lower ignition advance numbers.

You can also use the injector pulse for finding the Adj1 and Adj2 for TP calculation formula. After everything looks matching, its time to start building a trace for the run.

Building an ECU map trace based on a log file

Now that all this information is made available, it should not take long before someone writes a program that automatically traces ECU maps. Luckily also hand building a trace is a very simple process and unfortunately the only one available to us when writing this.

	12	**16**	**20**	**24**	**28**	**32**	**40**	**48**	**56**	**60**	**64**	**68**	**72**	**76**	**80**	**88**
400	15	15	10	5	5	5	123	123	123	123	123	123	123	123	123	123
800	15	20	24	23	21	21	13	8	0	126	125	124	124	124	124	124
1100	19	31	31	30	28	26	15	11	4	2	0	0	0	0	0	0
1200	20	35	34	32	31	27	18	14	8	5	3	3	3	3	3	3
1600	23	35	34	33	32	29	**24**	**21**	17	15	11	8	7	7	7	7
2000	28	40	39	36	35	33	**28**	**24**	**23**	20	18	13	11	11	11	11
2400	28	40	40	37	37	36	35	33	**29**	25	22	21	21	21	21	21
2800	28	45	45	43	42	40	36	33	**30**	28	27	27	27	27	27	27
3200	28	37	44	45	44	42	38	34	31	**29**	28	28	28	28	28	28
3600	28	37	44	46	45	43	39	34	32	30	**29**	29	29	29	29	29
4000	28	37	44	45	45	45	37	33	32	31	**30**	29	28	28	28	28
4400	28	37	44	45	45	45	37	33	31	30	29	**27**	25	25	25	25
4800	28	37	45	45	45	45	37	33	31	30	29	27	**25**	25	25	25
5200	28	37	45	45	45	45	37	31	29	29	27	26	**25**	25	25	25
5600	28	37	45	45	45	45	37	31	28	27	26	26	**26**	26	26	26
6000	28	37	45	45	45	45	37	31	28	28	28	28	28	**28**	28	28

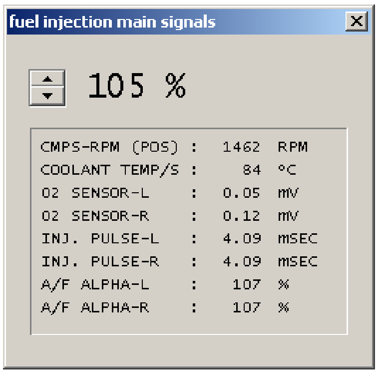
You simply use the RPM and TP figures from the run sheet and find matching rows and columns in ECU fuel and timing maps. By highlighting the corresponding ignition advance and fuel enrichment figures cells makes the maps much more readable. (Green color in the attached map)

After highlighting the figures, double check that the Timing and injector pulse figures from the highlighted part of the map match to the figures from log file. If there is a significant difference go back to the previous chapter and start finding the correct TP figure by inputting Adj1 and Adj2…. or start checking knock maps for matching if you are unfortunate to run in knock map mode. **(Note: For copyright reasons the attached map is not the actual map for the run, so you will find a mismatch in advance but correct cells are highlighted!)**

Usually during the trace and highlight I also make comments on possible improvements below the tables. When I find something interesting I may also highlight those cells with different color. This information becomes later very handy when its time to input figures to another excel to burn a new EPROM.

Now as you have completed building a trace for your engine run also do remember to post your engine configuration, k-value, Adj1 and Adj2 figures to forum.ztechz.net to make the process easier for other users.

Using ConZult to test improvements before burning an EPROM



The ConZult has two particularly useful features that an ECU tuner can utilize before deciding what to implement to the next EPROM burn. With ConZult you can tweak the fuel injection main signals and ignition signals. As you can easily detect this allows the user to test the fuel and timing map changes without a need to burn an EPROM. Currently you can only change these figures to the whole map and also logging while applying changes is disabled – but its good enough tool to see if changing the maps affects run times to reach the desired outcome.

At certain point of the tuning process I was getting detonation when tweaking the timing to get 6.6s runs. The runs become inconsistent so that sometimes I was getting 6.96s runs soon after a 6.6s run. By reading the engine logs generated by ConZult I could detect that on the runs leading to worse times showed slightly leaner A/F ratios, probably because of the automatic temperature adjustment on colder days. So I went back on the road and used ConZult to apply 5% more fuel across the fuel map and … I was consistently back on 6.6s again. As you can see, with ConZult you do not necessarily need an EPROM emulator to shorten the development of a new EPROM for your car.

Analyzing a sample run

On the couple of following pages is outlined a run, that is interesting from the learning perspective. It is so called failed run showing e.g. knock detection and some lean spots. Let me “disassemble” that to you piece by piece. Anyway I am no expert in the field of engine tuning or a professional tuner so if you have any comments to this chapter please let me know and maybe we together can improve this section.

To make it easy to understand, each point discussed here has a note in corresponding number highlighted yellow colored circle on the excel run sheets.

1. TP calculation – you may need to adjust this formula to get your TP to match to your injector size as explained earlier in this document. Anyway to analyze this run the figures are already correct.

2. Launch – As you can see from the O2 sensor readings, just after the launch the engine is running a bit lean. This happens as when the Throttle is opened with very fast speed the fuel generates

droplets to the intake manifold walls. The fuel does not disappear so if you add fuel here you probably need to take it away later. In my case you can also to see the injector pulse to peak at that moment fixing the fuel delivery. You can also see the TP figure to peak here as air is rushed through MAF sensor.

3. I launched using too high RPM and generated wheel spin. I have not yet found a way to detect wheel spin, but that's something you can and will do a mental note during the run to write as a comment on the sheet.

4. Here I made a check that at this point the ignition advance matches to the ECU map I was using. I do this check after every now and then to detect knock.

5. For a reason I do not know, the engine leaned out here for a short while. Probably an area to add fuel on the ECU map on the corresponding area in the crossing the RPM and TP figures.

6. When comparing my run to my ECU map I detected that the ECU had started to retard the ignition with a degree or two. From this I know that the knock sensor had detected knock. I can also see that the engine started to run lean again, so its time to add some fuel here. The reason may be that the ECU started to lean the engine using the A/F auto adjustment factors which I have not yet learned to control. You can affect these to some degree with the throttle enrichment though. In case of a TT you may get leaning out because you are running out of the capacity of the injectors, so this is particularly something for you to watch.

7. I know that on my ECU map the VTC release was programmed to 5400 rpm. As you can see the TP figures jumped soon after the VTC release so it may be beneficial to release it even sooner.

8. Here you can see that the RPM is starting to drop without a change in Throttle Sensor. That means that the gear change is taking place. At the particular moment of when the gear change started the TP was lower than after the gear change so it may be beneficial to make gear change happen a bit earlier as the TP indicates that I got more power out after the change than before. (Of course only dynoing this part would give me an exact answer.)

9. Here I realized based on the ignition figures mismatching to the ECU tables that I was getting knock again. Time to consider adding fuel here to lower the cylinder temperatures and by that preventing the detonation. It's worth while noticing that although the detonation seemed to end here its possible that it ended just because the ignition map might have detonation sensor disabled above 4000rpm at this point of the map. As I read from somewhere: "Apparently, it takes more retard to make the ping go away than it does to prevent it in the first place. This phenomenon is called knock hysteresis." So by retarding the timing by a degree you may gain two to make more power as the knock sensor does not come in to play. Be careful: when you can hear knock at higher RPM (>4000) then it is really strong knock that can be destructive in few seconds only. At higher RPM the knocking noise is mainly covered by mechanical noises as valves bouncing on their seats or piston slap.

10. The VTC on gear II indicates the same that the TP figure may go higher if VTC released a bit sooner.

11. The 5600 RPM does not necessarily match to 100km/h; I just use it as a pointer to compare end run timer values between different runs. Unfortunately ConZult does not give exact millisecond values, but if it is the only program running in the same laptop for different runs it seems to help seeing also which run happened faster. For actual timing of the runs I use Apexi RSM with G-sensor.

12. You can see the TPS sensor figures starting to go down, that's the moment where I depressed my accelerator pedal.

Sample RUN

	CLOCK	CMPS-RPI	MAS AIR/FL	O2 SEN/L	O2 SEN/R	VHCL S	THRTL F	INJ PULS	INJ PULS	IGN TIMIN	A/F-ALI	A/F-ALI	A/F ALF	A/F ALF	TP	((50/2)/256) * VQ * (K-value + Inj_void - 256) / RPM	
	13449	2050	2.28	0.64	0.74	0	1.26	7.39	7.47	30	108	110	110	110	47		
	13499	2062	2.27	0.8	0.81	0	1.26	7.25	7.37	30	108	110	110	110	46	1. TP calc	
	13529	2050	2.28	0.81	0.83	0	1.26	7.25	7.37	30	108	110	110	110	47		
	13569	2050	2.28	0.8	0.81	0	1.26	7.17	7.29	30	108	110	110	110	47		
	13619	2062	2.28	0.76	0.77	0	1.26	7.12	7.22	30	108	110	110	110	46		
	13659	2062	2.28	0.72	0.72	2.	[illegible]	7.04	7.16	30	108	110	110	110	46		
0	13689	2038	2.3	0.65	0.48	0	1.4	7.1	7.22	30	108	110	110	110	47	**Launch**	
50	13739	2012	2.52	0.48	0.29	0	2.16	13.1	13.32	32	99	110	101	110	67	Weather was colder and	
90	13779	2088	2.52	0.3	0.19	0	3.86	13.75	13.97	22	99	100	101	100	64	it was after rain for this run	
131	13820	2100	2.5	0.4	0.54	0	4.34	13.35	13.53	28	99	110	101	110	64	some wheelspin in the beginning	
171	13860	2138	2.49	0.85	0.84	0	4.34	12.95	13.09	34	99	110	101	110	63		
211	13900	2150	2.48	0.9	0.91	0	4.34	12.5	12.6	34	99	110	100	110	62		
251	13940	2175	2.47	0.92	0.93	0	4.34	12.2	12.28	34	100	110	100	110	55		
301	13990	2200	2.48	0.92	0.93	0	4.34	11.91	11.97	34	100	110	100	110	61		
331	[illegible]	3.Wheels	2.48	0.92	0.93	2	4.34	11.7	11.76	34	100	110	100	110	61		
371	14060	2200	2.47	0.91	0.92	2	4.34	11.42	11.46	34	100	110	100	110	55		
421	14110	2225	2.47	0.91	0.92	2	4.34	11.34	11.36	34	100	110	100	110	54		
461	14150	2262	2.49	0.91	0.91	2	4.34	11.3	11.32	34	100	110	100	110	59		
491	14180	2275	2.5	0.9	0.91	2	4.34	11.14	11.16	34	100	110	100	110	59		
541	14230	2312	2.48	0.9	0.91	2	4.34	10.78	10.78	34	100	110	100	110	58		
581	14270	2300	2.5	0.9	0.91	2	4.34	10.84	10.84	34	100	110	100	110	58		
621	14310	2312	2.52	0.89	0.91	2	4.34	10.87	10.87	34	100	110	100	110	58		
661	14350	2350	2.53	0.89	0.9	2	4.34	10.86	10.86	34	100	110	100	110	57		
701	14390	2362	2.51	0.89	0.9	2	4.34	10.5	10.5	34	100	110	100	110	57		
741	14430	2350	2.52	0.89	0.9	2	4.34	10.3	10.3	34	100	110	100	110	57		
791	14480	2325	2.53	0.89	0.9	2	4.34	10.29	10.29	34	100	110	100	110	58		
822	14511	2362	2.54	0.88	0.9	2	4.34	10.22	10.22	34	100	110	100	110	57		
872	14561	2362	2.54	0.88	0.89	2	4.34	10.1	10.1	34	100	110	100	110	57		
912	14601	2362	2.53	0.88	0.89	2	4.34	9.96	9.96	34	100	110	100	110	57		
952	14641	2375	2.53	0.87	0.88	2	4.34	9.77	9.77	34	100	110	100	110	56		
992	14681	2362	2.53	0.87	0.88	2	4.34	9.7	9.7	34	100	110	100	110	57		
1032	14721	2375	2.54	0.86	0.88	14	4.34	9.74	9.74	34	100	110	100	110	56		
1072	14761	2412	2.55	0.86	0.87	14	4.34	9.78	9.78	4.Ignition	100	110	100	110	56		
1112	14801	2462	2.55	0.85	0.86	14	4.34	9.75	[illegible]	[illegible]	100	110	100	110	54		
1152	14841	2438	2.56	0.84	0.86	14	4.34	9.7	9.7	34	100	110	100	110	61		
1192	14881	2512	2.57	0.84	0.86	14	4.34	9.74	9.74	35	100	110	100	110	59		
1242	14931	2538	2.58	0.83	0.85	14	4.34	9.78	9.78	34	100	110	100	110	59		
1282	14971	2588	2.6	0.82	0.84	14	4.34	9.82	9.82	34	100	110	100	110	58		
1312	15001	2638	2.63	0.81	0.84	14	4.34	9.97	9.97	35	100	110	100	110	56		
1362	15051	2675	2.64	0.82	[illegible]	[illegible]	4.34	10.01	10.01	35	100	110	100	110	62		
1402	15091	2700	2.67	0.78	5. Lean	[illegible]	4.34	10.13	10.13	35	100	110	100	110	61		
1442	15131	2788	2.68	0.74	0.75	14	4.34	10.16	10.16	34	100	110	100	110	59		
1482	15171	2812	2.71	0.72	0.73	14	4.34	10.34	10.34	34	100	110	100	110	59		
1523	15212	2838	2.73	0.71	0.71	14	4.34	10.48	10.48	34	100	110	100	110	64		
1563	15252	2900	2.76	0.71	0.72	14	4.34	10.83	10.83	35	100	110	100	110	63		
1613	15302	2962	2.8	0.73	0.74	14	4.34	11.3	11.3	34	100	110	100	110	68		
1643	15332	3012	2.81	0.77	0.78	14	4.34	11.32	11.32	34	100	110	100	110	66		
1683	15372	3075	2.82	0.81	0.83	14	4.34	11.28	11.28	34	100	110	100	110	65		
1733	15422	3125	2.84	0.83	0.85	14	4.34	11.32	11.32	34	100	110	100	110	64		
1773	15462	3175	2.85	0.84	0.86	22	4.34	11.34	11.34	35	100	110	100	110	63		
1803	15492	3225	2.86	0.85	0.86	22	4.34	11.32	11.32	35	100	110	100	110	62		
1853	15542	3275	2.88	0.85	0.87	22	4.34	11.42	11.42	35	100	110	100	110	67		
1893	15582	3300	2.87	0.85	0.87	22	4.34	11.22	11.22	35	100	110	100	110	61		
1933	15622	3388	2.89	0.85	0.87	22	4.34	11.01	11.01	35	100	110	100	110	65		
1973	15662	3412	2.91	0.86	0.87	22	4.34	11.14	11.14	35	100	110	100	110	64		
2013	15702	3462	2.93	0.85	0.87	22	4.34	11.43	11.43	35	100	110	100	110	63		
2053	15742	3538	2.95	0.86	0.87	22	4.34	11.24	11.24	35	100	110	100	110	62		
2103	15792	3575	2.97	0.86	0.87	22	4.34	11.52	11.52	35	100	110	100	110	67		
2133	15822	3625	2.96	0.86	0.87	22	4.34	11.5	11.32	35	100	110	100	108	66		
2173	15862	3700	2.98	0.87	0.88	22	4.34	11.37	11.37	35	100	110	100	110	65		3% More fuel here !!!
2224	15913	3762	3.02	0.87	0.88	22	4.34	11.64	11.64	35	100	110	100	110	64		3% More fuel here !!!
2264	15953	3812	3.02	0.87	0.88	22	4.34	11.46	11.4	35	100	110	100	109	63		3% More fuel here !!!
2294	15983	3875	3.04	0.87	0.88	22	4.34	11.01	11.69	35	100	103	100	110	67		3% More fuel here !!!
2344	16033	3912	3.07	0.87	0.88	22	4.34	11.75	11.17	35	100	110	100	104	67		3% More fuel here !!!
2384	16073	3975	3.08	0.86	0.88	22	4.34	11.4	6. Knock	35	100	105	100	109	66		3% More fuel here !!!
2424	16113	4050	3.08	0.86	0.87	22	4.34	11.76	10.76	33	100	110	100	100	64	**Knock knock**	3% More fuel here !!!
2464	16153	4112	3.12	0.86	0.87	32	4.34	10.84	11.52	33	100	100	100	106	69		3% More fuel here !!!
2504	16193	4162	3.14	0.85	0.86	32	4.34	11.16	10.94	34	100	102	100	100	68		3% More fuel here !!!
2544	16233	4238	3.14	0.84	0.86	32	4.34	10.86	10.86	34	100	100	100	100	67		3% More fuel here !!!
2594	16283	4275	3.18	0.82	0.85	32	4.34	11.02	11.02	34	100	100	100	99	66		3% More fuel here !!!
2624	16313	4325	3.19	0.8	0.83	32	4.34	11.11	11.11	34	100	100	100	99	66		3% More fuel here !!!
2664	16353	4400	3.22	0.78	0.82	32	4.34	11.2	11.18	34	100	100	100	99	70		3% More fuel here !!!
2714	16403	4462	3.24	0.77	0.82	32	4.34	11.28	11.28	34	100	100	100	99	69		3% More fuel here !!!
2754	16443	4575	3.29	0.77	0.82	32	4.34	11.58	11.58	34	100	100	100	99	73		3% More fuel here !!!
2794	16483	4625	3.3	0.77	0.82	32	4.34	11.62	11.62	34	100	100	100	99	72		3% More fuel here !!!
2834	16523	4675	3.34	0.79	0.82	32	4.34	11.8	11.8	33	100	100	100	99	71	**Knock knock**	3% More fuel here !!!
2874	16563	4738	3.36	0.8	0.81	32	4.34	11.86	11.86	33	100	100	100	99	76		3% More fuel here !!!
2915	16604	4812	3.37	0.81	0.82	32	4.34	11.86	11.86	33	100	100	100	99	75		3% More fuel here !!!
2955	16644	4900	3.39	0.82	0.82	32	4.34	11.89	11.89	33	100	100	100	99	73		3% More fuel here !!!
2995	16684	4950	3.41	0.82	0.82	32	4.34	11.93	11.93	33	100	100	100	99	73		3% More fuel here !!!
3035	16724	5000	3.42	0.82	0.82	32	4.34	11.92	11.92	33	100	100	100	99	72		3% More fuel here !!!
3085	16774	5050	3.43	0.82	0.82	32	4.36	11.98	11.98	33	100	100	100	99	71		3% More fuel here !!!
3115	16804	5112	3.45	0.82	0.83	32	4.34	11.97	11.97	33	100	100	100	99	76		3% More fuel here !!!
3165	16854	5212	3.46	0.83	0.84	45	4.34	11.95	11.95	33	100	100	100	99	74		3% More fuel here !!!
3205	16894	5275	3.47	0.83	0.85	45	4.34	11.92	11.92	33	100	[illegible]	[illegible]	99	74		3% More fuel here !!!
3245	16934	5338	3.5	0.82	0.85	45	4.34	12.03	12.03	33	100	7. VTC	[illegible]	99	73		3% More fuel here !!!
3285	16974	5425	3.5	0.82	0.85	45	4.34	11.9	11.9	33	100	100	100	99	72		3% More fuel here !!!
3325	17014	5438	3.51	0.82	0.85	45	4.34	11.87	11.87	33	100	100	100	99	71	**VTC**	3% More fuel here !!!
3365	17054	5500	3.52	0.82	0.85	45	4.34	11.82	11.82	33	100	100	100	99	76		3% More fuel here !!!
3405	17094	5588	3.53	0.81	0.85	45	4.34	11.82	11.82	33	100	100	100	99	75		3% More fuel here !!!
3445	17134	5600	3.53	0.81	0.85	45	4.34	11.77	11.77	33	100	100	100	99	75		3% More fuel here !!!
3485	17174	5650	3.55	0.8	0.85	45	4.34	11.81	11.81	33	100	100	100	99	74		3% More fuel here !!!
3535	17224	5762	3.56	0.8	0.85	45	4.34	11.84	11.84	33	100	100	100	99	72		3% More fuel here !!!
3575	17264	5825	3.58	0.79	0.84	45	4.34	11.88	11.88	33	100	100	100	99	72		3% More fuel here !!!
3606	17295	5888	3.59	0.8	0.85	45	4.36	11.9	11.9	34	100	100	100	99	71		3% More fuel here !!!
3656	17345	5925	3.61	0.81	0.85	45	4.34	11.96	11.96	34	100	100	100	99	76		3% More fuel here !!!
3696	17385	6000	3.64	0.81	0.85	45	4.34	12.08	12.08	34	100	100	100	99	75		
3736	17425	6025	3.65	0.8	0.84	45	4.34	12.13	12.13	34	100	100	100	99	74		
3776	17465	6100	3.69	0.8	0.85	45	4.34	12.32	12.32	33	100	100	100	99	79		
3816	17505	6188	3.69	0.8	0.86	45	4.34	12.27	12.27	34	100	100	100	99	78		
3856	17545	6250	3.7	0.81	0.86	57	4.34	12.21	12.21	33	100	100	100	99	77		
3906	17595	6338	3.71	0.81	0.86	57	4.36	12.23	12.23	34	100	100	100	99	76		
3936	17625	6350	3.71	0.81	0.85	57	4.34	12.16	12.16	34	100	100	100	99	76		
3976	17665	6400	3.71	0.82	0.85	57	4.36	12.01	12.01	34	100	100	100	99	75		

4026	17715	**6462**	3.71	0.83	0.86	57	4.36	11.92	11.92	**34**	100	100	100	99	**74**	
4066	17755	**6525**	3.72	0.83	0.86	57	4.36	11.92	11.92	**34**	100	100	100	99	**74**	
4096	17785	**6562**	3.72	0.83	0.86	57	4.36	11.85	11.85	**34**	100	100	100	99	**73**	
4146	17835	**6575**	3.71	0.83	0.86	57	4.36	11.72	11.72	**34**	100	100	100	99	**73**	
4186	17875	**6688**	3.72	0.83	0.86	57	4.36	11.71	11.71	**34**	100	100	100	99	**72**	
4226	17915	**6725**	3.74	0.83	0.86	57	4.36	11.76	11.76	**34**	100	100	100	99	**71**	
4266	17955	**6775**	3.74	0.83	0.85	57	4.34	11.7	11.68	**34**	100	100	100	99	**71**	
4307	17996	**6838**	3.74	0.84	0.86	57	4.36	11.62	11.62	**34**	100	100	100	99	**70**	
4347	18036	**6912**	3.75	0.84	0.86	57	4.34	11.58	11.58	**34**	100	100	100	99	**70**	
4397	18086	**6950**	3.75	0.84	0.86	57	4.36	11.52	11.52	**34**	100	100	100	99	**69**	
4427	18116	**6988**	3.75	0.84	0.86	57	4.34	11.42	11.42	**34**	100	8. GEAR	[illegible]	99	**69**	
4467	18156	**6988**	3.75	0.84	0.86	57	4.34	11.38	11.38	**34**	100	100	100	99	**69**	
4517	18206	**6912**	3.75	0.83	0.86	57	4.36	11.4	11.4	**34**	100	100	100	99	**70**	**GEAR II**
4557	18246	**6800**	3.75	0.83	0.86	57	4.36	11.42	11.42	**34**	100	100	100	99	**71**	Maybe shift a bit earlier as exit TP
4597	18286	**6612**	3.74	0.83	0.86	67	4.36	11.58	11.58	**34**	100	100	100	99	**73**	is higher than entry TP
4637	18326	**6362**	3.72	0.83	0.86	67	4.36	11.8	11.8	**34**	100	100	100	99	**76**	
4677	18366	**6075**	3.71	0.82	0.85	67	4.34	12.13	12.13	**34**	100	100	100	99	**79**	
4717	18406	**5825**	3.67	0.82	0.86	67	4.34	12.14	12.14	**34**	100	100	100	99	**77**	
4757	18446	**5562**	3.59	0.82	0.86	67	4.34	11.86	11.86	**33**	100	100	100	99	**75**	
4797	18486	**5375**	3.52	0.84	0.87	67	4.36	11.63	11.63	**33**	100	100	100	99	**78**	
4837	18526	**5075**	3.46	0.85	0.87	67	4.36	11.6	11.6	**34**	100	100	100	99	**76**	
4887	18576	**4800**	3.41	0.85	0.87	67	4.36	11.59	11.59	**34**	100	100	100	99	**75**	
4917	18606	**4512**	3.33	0.86	0.87	67	4.36	11.38	11.38	**34**	100	100	100	99	**74**	
4957	18646	**4362**	3.25	0.86	0.87	67	4.36	11.16	11.16	**35**	100	100	100	99	**70**	
5008	18697	**4400**	3.22	0.86	0.87	67	4.36	11.03	11.03	**35**	100	100	100	99	**70**	
5048	18737	**4488**	3.24	0.86	0.87	67	4.34	11.23	11.23	**34**	100	100	100	99	**68**	
5088	18777	**4575**	3.28	0.85	0.85	67	4.36	11.44	11.44	**34**	100	100	100	99	**73**	
5128	18817	**4625**	3.3	0.84	0.85	67	4.34	11.58	11.58	**34**	100	100	100	99	**72**	
5168	18857	**4600**	3.31	0.84	0.84	67	4.34	11.64	9. Knock	[illegible]	100	100	100	99	**72**	
5208	18897	**4600**	3.32	0.83	0.84	67	4.36	11.72	[illegible]	**33**	100	100	100	99	**72**	**Knock knock**
5248	18937	**4600**	3.32	0.84	0.84	67	4.34	11.72	11.72	**33**	100	100	100	99	**72**	
5288	18977	**4675**	3.33	0.84	0.84	77	4.34	11.73	11.73	**33**	100	100	100	99	**71**	
5338	19027	**4688**	3.35	0.84	0.84	77	4.36	11.85	11.85	**33**	100	100	100	99	**71**	
5378	19067	**4725**	3.35	0.84	0.84	77	4.34	11.84	11.84	**33**	100	100	100	99	**70**	
5408	19097	**4700**	3.36	0.84	0.84	77	4.34	11.84	11.82	**33**	100	100	100	99	**77**	
5458	19147	**4725**	3.37	0.84	0.84	77	4.36	11.9	11.9	**33**	100	100	100	99	**76**	
5498	19187	**4788**	3.37	0.84	0.84	77	4.36	11.92	11.92	**33**	100	100	100	99	**75**	
5538	19227	**4800**	3.38	0.84	0.84	77	4.36	11.94	11.94	**33**	100	100	100	99	**75**	
5578	19267	**4812**	3.38	0.84	0.84	77	4.34	11.88	11.88	**33**	100	100	100	99	**75**	
5618	19307	**4812**	3.38	0.84	0.84	77	4.36	11.84	11.84	**33**	100	100	100	99	**75**	
5658	19347	**4850**	3.4	0.83	0.84	77	4.36	11.96	11.96	**33**	100	100	100	99	**74**	
5709	19398	**4900**	3.39	0.84	0.84	77	4.36	11.92	11.92	**33**	100	100	100	99	**73**	
5739	19428	**4888**	3.4	0.84	0.84	77	4.36	11.92	11.92	**33**	100	100	100	99	**74**	
5779	19468	**4938**	3.42	0.84	0.84	77	4.36	12	12	**33**	100	100	100	99	**73**	
5829	19518	**4938**	3.41	0.84	0.84	77	4.36	11.96	11.96	**33**	100	100	100	99	**73**	
5869	19558	**4950**	3.41	0.84	0.84	77	4.36	11.94	11.94	**33**	100	100	100	99	**73**	
5899	19588	**5000**	3.43	0.84	0.84	77	4.36	11.99	11.99	**33**	100	100	100	99	**72**	
5949	19638	**4975**	3.42	0.83	0.84	77	4.36	11.92	11.92	**33**	100	100	100	99	**72**	
5989	19678	**5012**	3.43	0.84	0.84	83	4.36	11.92	11.92	**33**	100	100	100	99	**72**	
6029	19718	**5012**	3.44	0.84	0.85	83	4.36	12	12	**33**	100	100	100	99	**77**	
6069	19758	**5050**	3.44	0.84	0.85	83	4.36	11.94	11.94	**33**	100	100	100	99	**77**	
6109	19798	**5062**	3.43	0.84	0.84	83	4.36	11.87	11.87	**33**	100	100	100	99	**71**	
6149	19838	**5100**	3.45	0.84	0.84	83	4.36	11.98	11.98	**33**	100	100	100	99	**76**	
6199	19888	**5125**	3.45	0.83	0.84	83	4.34	11.92	11.92	**33**	100	100	100	99	**76**	
6229	19918	**5075**	3.45	0.84	0.84	83	4.36	11.9	11.9	**33**	100	100	100	99	**76**	
6269	19958	**5100**	3.45	0.83	0.84	83	4.34	11.92	11.92	**33**	100	100	100	99	**76**	
6319	20008	**5100**	3.45	0.84	0.84	83	4.34	11.92	11.92	**33**	100	100	100	99	**76**	
6359	20048	**5125**	3.46	0.83	0.84	83	4.34	11.92	11.92	**33**	100	100	100	99	**76**	
6390	20079	**5075**	3.45	0.83	0.84	83	4.36	11.9	11.9	**33**	100	100	100	99	**76**	
6440	20129	**5075**	3.45	0.83	0.84	83	4.36	11.95	11.95	**33**	100	100	100	99	**76**	
6480	20169	**5112**	3.45	0.84	0.84	83	4.36	11.91	11.91	**33**	100	100	100	99	**76**	
6520	20209	**5138**	3.47	0.83	0.84	83	4.36	12	12	**33**	100	100	100	99	**76**	
6560	20249	**5112**	3.46	0.83	0.84	83	4.36	11.98	11.98	**33**	100	100	100	99	**76**	
6600	20289	**5125**	3.45	0.83	0.84	83	4.36	11.94	11.94	**33**	100	100	100	99	**76**	
6640	20329	**5138**	3.46	0.84	0.84	83	4.36	11.93	11.93	**33**	100	100	100	99	**76**	
6690	20379	**5188**	3.47	0.84	0.84	91	4.34	12	12	**33**	100	100	100	99	**75**	
6720	20409	**5162**	3.46	0.83	0.84	91	4.34	11.94	11.94	**33**	100	100	100	99	**75**	
6760	20449	**5175**	3.47	0.83	0.84	91	4.36	12.01	12.01	**33**	100	100	100	99	**75**	
6810	20499	**5188**	3.47	0.83	0.84	91	4.36	11.96	11.96	**33**	100	100	100	99	**75**	
6850	20539	**5212**	3.47	0.84	0.84	91	4.36	11.92	11.92	**33**	100	100	100	99	**74**	
6890	20579	**5188**	3.47	0.83	0.84	91	4.36	11.86	11.86	**33**	100	100	100	99	**75**	
6930	20619	**5212**	3.47	0.83	0.84	91	4.36	11.9	11.9	**33**	100	100	100	99	**74**	
6970	20659	**5225**	3.48	0.83	0.84	91	4.36	11.92	11.92	**33**	100	100	100	99	**74**	
7010	20699	**5225**	3.48	0.83	0.84	91	4.36	11.96	11.96	**33**	100	100	100	99	**74**	
7050	20739	**5325**	3.49	0.83	0.84	91	4.34	11.94	11.94	**33**	100	100	100	99	**73**	
7091	20780	**5275**	3.48	0.83	0.84	91	4.34	11.88	11.88	**33**	100	100	100	99	**74**	
7131	20820	**5325**	3.48	0.83	0.84	91	4.36	11.88	11.88	**33**	100	100	100	99	**73**	
7181	20870	**5338**	3.49	0.83	0.84	91	4.36	11.86	11.86	**33**	100	100	100	99	**73**	
7211	20900	**5338**	3.5	0.83	0.84	91	4.36	11.88	11.88	**33**	100	100	100	99	**73**	
7261	20950	**5375**	3.51	0.83	0.84	91	4.36	11.92	11.92	**33**	100	10. VTC	[illegible]	99	**72**	
7301	20990	**5388**	3.5	0.82	0.84	91	4.36	11.84	11.84	**33**	100	[illegible]	[illegible]	99	**72**	
7341	21030	**5400**	3.5	0.83	0.84	91	4.36	11.84	11.84	**33**	100	100	100	99	**72**	
7381	21070	**5438**	3.53	0.82	0.84	91	4.36	12.04	12.04	**33**	100	100	100	99	**77**	
7421	21110	**5425**	3.53	0.82	0.84	97	4.36	11.99	11.99	**33**	100	100	100	99	**77**	
7461	21150	**5500**	3.52	0.83	0.85	97	4.36	11.94	11.94	**33**	100	100	100	99	**76**	
7501	21190	**5475**	3.53	0.83	0.85	97	4.36	11.88	11.88	**33**	100	100	100	99	**76**	
7541	21230	**5500**	3.53	0.83	0.85	97	4.36	11.88	11.88	**33**	100	100	100	99	**76**	
7581	21270	**5550**	3.53	0.83	0.84	97	4.36	11.8	11.8	**33**	100	100	100	99	**75**	
7631	21320	**5538**	3.53	0.82	0.85	97	4.36	11.86	11.86	**33**	100	100	100	99	**75**	
7671	21360	**5562**	3.54	0.82	0.84	97	4.36	11.94	11.94	**33**	100	100	100	99	**75**	
7701	21390	**5600**	3.54	0.82	0.85	97	4.34	11.87	11.87	**33**	100	100	100	99	**75**	
7751	21440	**5612**	3.55	0.82	0.85	97	4.36	11.88	11.88	**33**	100	100	100	99	**74**	
7792	21481	**5600**	3.56	0.82	0.84	97	4.36	11.92	11.92	**33**	100	100	100	99	**75**	**6.96s**
11. Timer	[illegible]	**5650**	3.56	0.82	0.84	97	4.36	11.94	11.94	**33**	100	100	100	99	**74**	
	[illegible]	**5700**	3.56	0.82	0.84	97	4.36	11.93	11.93	**33**	100	100	100	99	**73**	
	21601	**5675**	3.57	0.82	0.84	97	4.36	11.92	11.92	**33**	100	100	100	99	**74**	
	21641	**5700**	3.58	0.82	0.84	97	4.34	11.98	11.98	**33**	100	100	100	99	**73**	
	21691	**5700**	3.58	0.82	0.84	97	4.34	11.94	11.94	**33**	100	100	100	99	**73**	
	21721	**5725**	3.59	0.82	0.84	97	4.34	11.96	11.96	**33**	100	100	100	99	**73**	
	21761	**5762**	3.59	0.82	0.84	97	4.34	11.98	11.98	**33**	100	100	100	99	**72**	
	21811	**5812**	3.59	0.82	0.84	103	4.26	12. END	11.97	**33**	100	100	100	99	**72**	
	21851	**5838**	3.6	0.83	0.85	103	4.06	[illegible]	[illegible]	**34**	100	100	100	99	**77**	
	21881	**5862**	3.6	0.83	0.85	103	3.82	12	12	**33**	100	100	100	99	**76**	

Getting repetitive results on street

Very important part of car tuning is a process that helps in getting repetitive results run after run. There is no value in measuring e.g. the 0-100km/h acceleration times if there is a 0.2s difference between the runs, hence a lot of attention must be paid to get consistent results. What I have studied and learned indicates that the key in getting consistent results is a sum of three below mentioned subjects:

1) Using a good measuring gauge
2) Eliminating human factors
3) Taking the external factors into account

The first two elements are easier to control. I chose to use Apexi RSM as my measuring device as it uses both G-meter and speed sensor input. In principle one could use a hand timer, but that introduces a human error factor that needs to be avoided. Apexi RSM starts from movement of the car and corrects the wheel speed figures based on G-sensor feedback making it very accurate. The launch and gear shifts are the main points where a human error can interfere. Eliminating human factors with an auto tranny car is much easier than with a manual. Launch can be made a repetitive event by keeping the launch RPM always constant and gear change can be automated. If there is variation with launch RPM that can be read from the ConZult enginelog making the comparison between launches very comparable.

The last point is much more difficult to control as there are several factors affecting the results. Below is a list of few to be taken into consideration.

- Tire pressure - needs to be checked before run and the tire temperature needs to be the same for each run, otherwise e.g. the tire resistance caused by the side wall compression affects the run times.
- Wind – the wind resistance co-efficient is usually unchanged (unless you drive without T-tops), but end result is affected if you drive against or with the wind
- Mass of car and driver – The acceleration times is very dependant on the mass of the car. Hence the amount of fuel needs to be approximately the same for each run.
- Going uphill or downhill affects highly acceleration times; hence the same piece of road should always be used. Never use the roads after the rain just to avoid wheel spin affecting your results.
- Outside temperature – affects both the contact to the road and the mass of air entering to the engine. The outside temperature needs to be appr. the same for each run.
- Self learn factors – depending on what kind of driving has been taken place before the launch the self learn factors may be set differently between launches.

As you can see, there are many variables to be taken into account before you can start calling the results objective results based on facts. The best advice perhaps is that: first practice without any tuning until you get consistent results. As soon as your runs are within a couple of 1/100 seconds then you are ready to start introducing changes to your ECU maps and able to measure the effects of the improvements made.

Using other data logging tools than ConZult

This document was written to describe the street tuning process with ConZult. Anyhow the same principles work with any other data logging tools – as long as you can collect the sensor data needed for this process.

The sensors that are essential for engine tuning are the following:

- **RPM** to detect at which particular point of the map the engine is running
- **MAF** to be used on the basis of TP calculation to detect at which particular point on the map the engine is running
- **Ignition advance**
    - To be used in adjusting the TP calculation formula for traces. Using only ignition advance without fuel injection pulse can be difficult due to the detonation sensor effect.
    - To see if detonation sensor is affecting the ignition advance so that the advance needs to be retarded. You can choose to run the maps knock sensor disabled to get the TP

calculation adjustments correct, but still double checking with fuel injector pulse information is highly recommended.

- **O2 sensor information**
  - This is used in detecting any lean spots during the runs

Other sensors that are very useful but not necessary:

- **Fuel injector pulse, ms**
  - To be used in adjusting the TP calculation formula for traces as ignition advance can be affected with knock sensor and being retarded. Also injector pulse can be adjusted with +-10% or even more, so hence using both ignition advance and fuel injector pulse is recommended
- **Throttle position sensor** voltage to see the start and end of the run
- **Engine temperature sensor** output affects timing especially when the engine is cold
- **Fuel temperature sensor** affects the fuel injector pulse width especially when the engine is cold

Technically you could develop a software package and an A/D board for you for most of the sensors. The most difficult ones are the RPM and Ignition advance for which you need to have a timer that can measure milliseconds or frequencies and frequency shifts.

Tranny, power losses, bolt on upgrades and tweaks

Although this document is dedicated to fine-tuning an ECU, most of the gains can only be made when combined with bolt on upgrades.

Optimizing the auto tranny

When driving an auto tranny car it is perceived that you do not need to change a gear, just floor it. The first lesson to be learned was a proper launch with power braking. Then I learned, that to fully utilize the high end power band of the NA engine the auto gearbox is shifting way too early – so I started to hand move the stick at around 6.800 rpm. Regarding the launch I soon realized that any wheel spin after power braking probably increases the time needed for acceleration. The proper launch RPM seems to be around 1.800 – rpm, anything above that and I get wheel spin making the acceleration slower. Implementing these two things brought the acceleration times down to around 7.04- 7.2s, but I was still not happy. It was time to consider getting an upgrade how fast the tranny shifts –HKS ALCII seemed to be the answer.

HKS ALC is a device that increases and maintains the line pressure higher for making the shift feel faster. As such it does not necessarily much improve the acceleration times, but when combining with manual shifting I was definitely able to improve acceleration times. Depending on how well I managed to get the shift point right I was now constantly running 6.86-7.18 times. As it's already difficult to get the launch right, I then decided to minimize the possibility for user shift timing error by connecting my Apexi RSM to the auto tranny. This made the 1->2 gear shift happen automatically at predefined speed and the runs almost started to be constant in between 6.86 - 6.96.

Minimizing the power losses

In the early phases I soon noticed how important the factors of engine power losses are. Sometimes when I forgot the aircon on it immediately raised the times by around 0.2s. Also having lights or other electrical devices like fan turned on seemed to cause power losses by increasing the alternator load for worth of a tenth or two. So now when doing acceleration tests I turn everything off well before the launch and make sure that my battery is well charger.

Other source of power losses is the contact to the road. If wheel spin is not an issue after the launch, a lower tire pressure seems to cause a some power loss as some of the power is needed to overcome the higher rolling resistance. Today I am running with relatively high tire pressure of 2.5ata / 35psi and getting best results with standard radials. The front tires are usually pumped to a bit higher pressure than the rears.

Also increased weight causes power losses as the engine needs to get a larger mass moving. This applies to both to the car body and also to the moving parts like wheels and pulleys. One easily controllable area is the amount of fuel put into the tank. The best results are achieved when there is one quarter or less fuel in the tank. The rotational mass e.g. in engine pulleys and even in wheels which is something that is less often considered. Anyhow bigger wheels do offer larger contact to the road to reduce wheel spin but in an underpowered car like Z32 NA and stock TT bigger wheels can also make the acceleration slower as the bigger tires and wheels are sometimes heavier than stock wheels. As part of the 100k km service I installed an UDP from SGP racing which reduced the rotational mass in my crank shaft making the engine rev faster. I am also reading reports that choosing the right oil to engine and tranny minimizes the power losses.

Making power out of an engine

On an NA engine the area to be considered is really only how well the engine is breathing – unless you decide go and get cams installed or increase compression ratios. In stock VG30DE there are a couple of areas where there is some resistance and turbulence generated making the breathing more restricted. I do not have any scientifical proof that any of this works, but all of this seems to be logical.

For POP I decided to go with JWT as they seemed to have optimized the air flow best with the venturi. When installing POP do remember that the airflow coming outside to the POP can generate turbulence to make venture less efficient so install the POP according to JWT instructions so that it does not directly hit the airflow.

The first restriction after POP in the engine is the MAF sensor which has a net at the both end to both protect the sensor element and to generate turbulence to the air. I decided to remove the net at the back of the sensor and felt better engine response. As I am tracking the O2 sensor readings for my engine runs I now also know that removing the net did not generate any major problems or fluctuations with MAF output – although the response felt could be only because of different flow characteristics of air hitting the sensor

MAF is connected to the T tube intake hose which splits the airflow to the both sides of the engine. Inside the T-tube there is a molded ring that you can feel by sliding your fingers to the sides from the hole to which MAF is attached. To me that ring was designed in case another type of MAF is attached and it just generates unwanted turbulence so I decided to remove it with a knife – and yet again felt a better response from the engine.

The intake hoses are connected to the throttle bodies on both sides. Usually after a couple of years the plenum becomes dirty and affects the airflow, so cleaning it with carb cleaner helps both idle and airflow. When full throttle is applied through the throttle cable the discs are moved almost vertical to the airflow, but not quite. The throttle body tweak allows the discs to become completely vertical by bending the limiter in the cable guide. I don't know if this modification improves flow or generates more turbulence but I have anyway implemented it to minimize the restriction.

In addition to the above there are no major modifications made to my engine. Currently I am still even running a stock exhaust, so there is more to do to get the engine breath better. Instead of hardware modifications I learned that hours spent in getting most out of the engine by reprogramming the ECU is the way forward – bolt on modifications do not really seem to increase power unless the ECU parameters are changed accordingly.

Summary

This document is far from being a complete guide of how to use ConZult data log files for chip tuning. The more we share the experience the more we learn about causes and effects, so let's keep the information flowing freely. At the end - engine tuning is a hobby with the goal being continuous improvement to get the most out of our engine.

Some persons are putting a lot of investment into developing tools for engine tuning and parts for tuned engines – lets also value that investment as without the parts and services our cars soon cease to exist. E.g. this document explains the basics of utilizing a data logging tool to improve runs using ConZult. For a competition minded serious tuner a tool called Zemulator could be a better alternative than manipulating a file of raw excel data. Someone with a lot of time and programming skills with this information available - you could start building software of your own based on a standard A/D board.

The choice of tools you use is up to you - in thinking about the alternatives, it is good to bear in mind that the cost of ConZult is only EUR350 / 450USD providing also a lot of other very useful features. For me ConZult really is a prerequisite for successful ECU tuning, but there may be added benefits of having other products in addition to ConZult.

