EDC-16C9/C39

Written by: Someone
Date: 2014
Thanks to: A lot of helpful forum members!
For more info: **www.ecuconnections.com**
Revision: 1.4

Index:

Introduction:

The EDC16C9 and EDC16C39 are used in Opel Vectra, Fiat Chroma, Alfa 156, SAAB 9000 and some other cars that use 1.9cdti engine. The system looks a lot like the EDC15 system, but the EDC16 system is based on Torque (Nm) instead of Injected Quantity. There are a few more differences that are explained in this document. For the examples in this document I used the pro tuned Opel Astra 1.9 cdti 16v 150bhp file. The pictures show tuned file and difference from original by Delta or %.

I chose to use different values in my remap, hope my explanation will not be confusing for you.
Here you can find the pro tuned file:
http://www.ecuconnections.com/forum/viewtopic.php?f=152&t=15660&p=81062&hilit=pro+astra+150#p81062
There are some mistakes in map-pack…

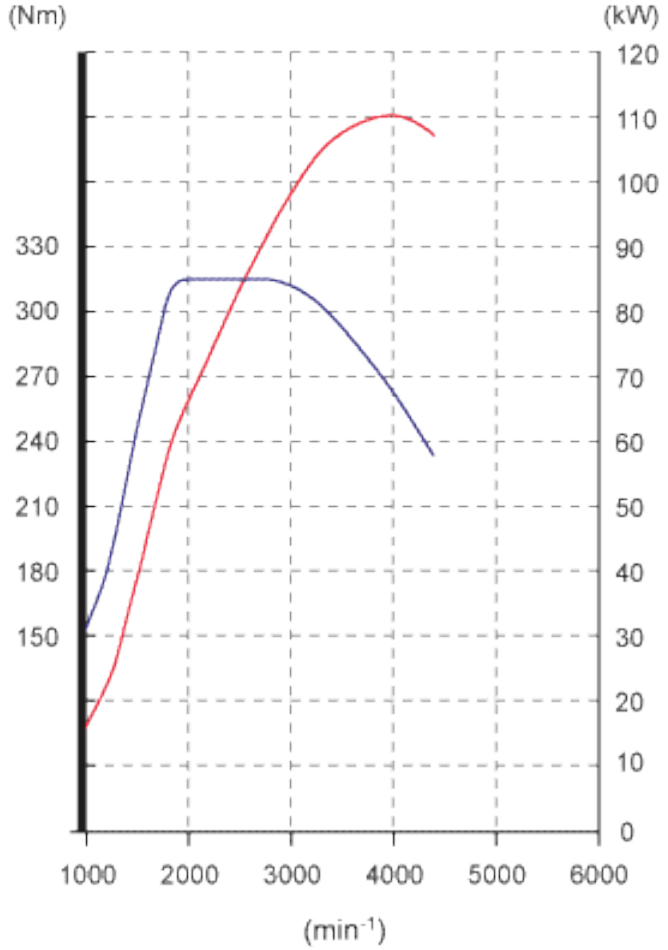
This Guide has no intention to show how to save money by DIY remap as it is a Mission Impossible. This Guide intends to brief you about control and operation of the 1.9 DTH engines so can enjoy playing with it. Be aware that this could be an expensive hobby. Have fun.

Car data

Z19DTH - 1.9CDTI 150BHP

Engine Specification
Engine, location: Front, transverse in front of axle 17º 24' forward inclined
Cooling system: Liquid, sealed circuit
Cylinders, number: 4
Bore (mm) 82
Stroke (mm): 90.4
Displacement (cc): 1910
Compression ratio: 17.5: 1
Engine, type: In line; 5 main bearings
Cylinder block/ head, material: Cast iron/ aluminium
Camshaft (s), location: 2 overhead (DOHC), driven by toothed belt
Valve train: Indirect, roller cam followers
Valve, arrangement: In line; 4 per cylinder Valve,
Adjustment: Automatic - hydraulic
Fuel system: Diesel direct injection, common rail
Ignition system: n/a
Fuel pump: High pressure mechanic
Emission control system: 2- way cat. conv. (oxidizing catalytic converter) exhaust gas recirculation DPF
Output (kW/hp CEE at 1/min): 110/ 150 at 4000
Specific power (kW/l; hp/l): 57.6; 78.5
Max. torque (Nm at 1/ min): 315 at 2000
Specific torque (Nm/litre): 164.9
Mean effective pressure at max. power/ max. torque (kPa):1727.7/ 2073.4
Average piston speed (m/ s): 12.1
Engine oil, capacity (l): 4.3
Cooling capacity (l): 7.5
Battery 12 V,

capacity (Ah): 70
Alternator 14.2 V,
Capacity (W): 1420
Max. service interval: 20,000 miles or 1 year
Emission compliance: Euro 4
Engine mass (kg): tba
Charger system: Turbo with intercooler
Max. boost pressure (bar): tba

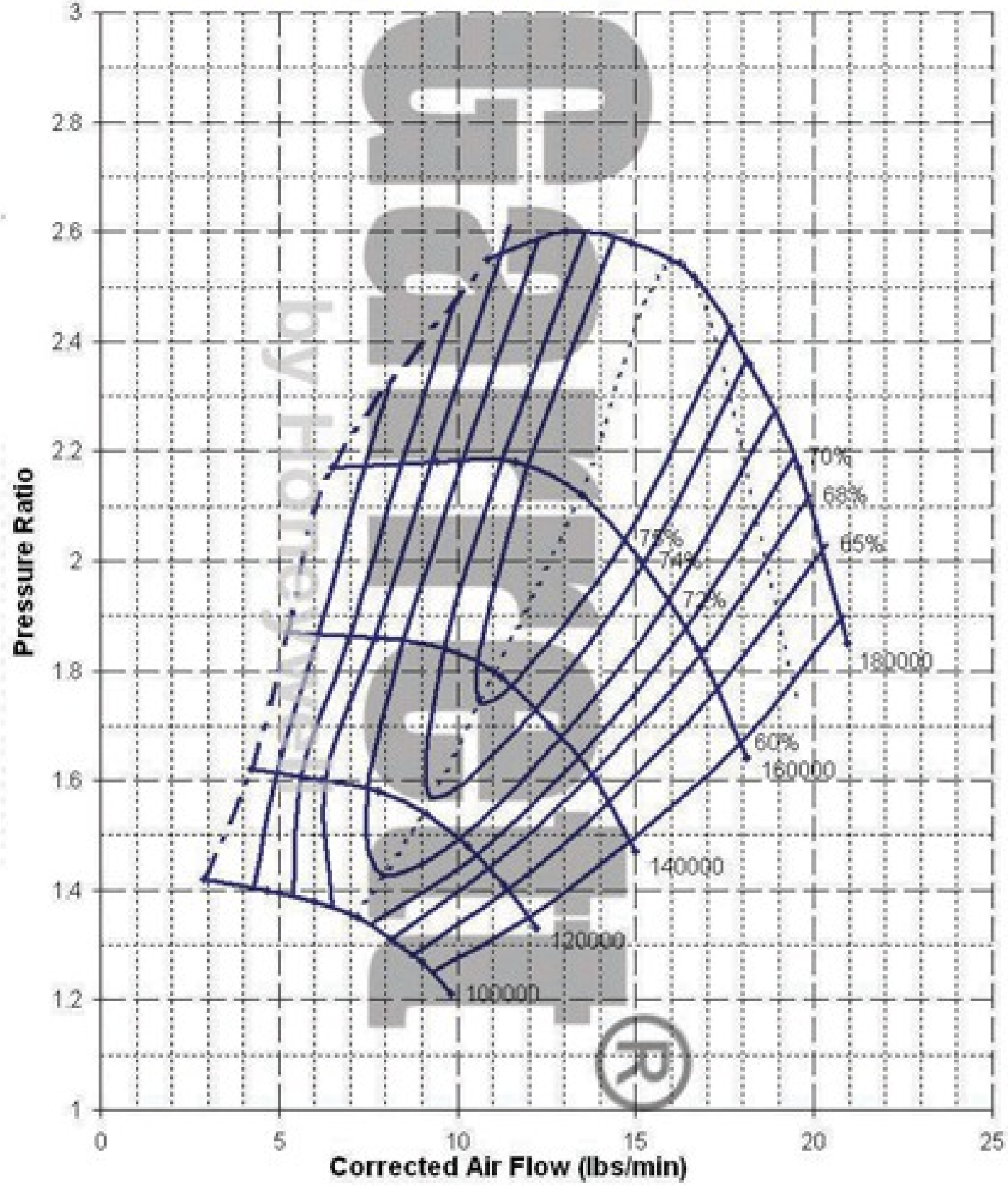


Power Output (kW) Torque (Nm)

2009 Aisin Warner AF40-6 (M36) FWD & (MXE) AWD Transmission	
Type:	six speed front wheel drive, electonically controlled automatic tansmission with torque converter clutch
Maximum engine torque:	400 Nm (Gasoline), 450 Nm (Diesel)
Gear Ratios:	**M36 & MXE**
1st	4.15
2nd	2.37
3rd	1.56
4th	1.16
5th	0.86
6th	0.69
REV	3.39
F/D	2,561 / 2,666 / 2,774 / 2,839 / 2,955 / 3,075 / 3,200 / 3,329 / 3,464 / 3,640 / 3,750
Ratio spread	6,05:1
Maximum shift speed:	7000 rpm

Min input speed:	650 rpm
Maximum validated gross vehicle weight:	2355 kg (MY09 Opel Insignia HB AF40 AWD A28NET)
Shifting mechanism:	Integrated position sensor with TCM
Shifting positions:	P,R,N,D (by cable) & Tiptronic (by CAN)
Case material:	Die cast aluminum
Center distance:	197 mm
Overall length:	358 mm
Shift pattern:	Pulse width modulated solenoid control
Shift quality:	Variable bleed solenoid
Torque converter clutch:	Pulse width modulated solenoid control
Available control features:	Eco Mode Selective Sport Mode Drivers Adaptive (Fuzzy) Manual Mode (Tiptronic) Up Hill Control Down Hill Control Torque Limitation (axle shaft protection) Fast Acceleration OFF Fast Acceleration ON Shift by Temperature Brake Assist Cornering Control Pass-by Noise Test Function Differential Protection Warm-up Shift Pattern (WUSP) Neutral Control L-up Slip Control (drive & coast) Tip Auto Down Tip Auto Up Improved Downshift Protection Up Shift Prevention Low m Conrol Highest Gear in Limp Home Gear Stabilization
EOBD II, OBD	
Converter size:	241 & 260
k-Factor:	142k - 225k
Torque ratio:	2,0 - 2,32
Fluid type	AW-1 (low friction), lifetime fill
Transmission weight (dry):	87 kg
Fluid capacity	6,96 kg (incl. cooler)
Pressure taps available:	Access to all clutches & brakes possible
Assmbly site:	Anjo City, Japan
Applications:	Opel Astra, Zafira, Vectra Saab 9-3, Cadillac BLS

GT1749V, 49mm, 55 Trim, 0.46 A/R



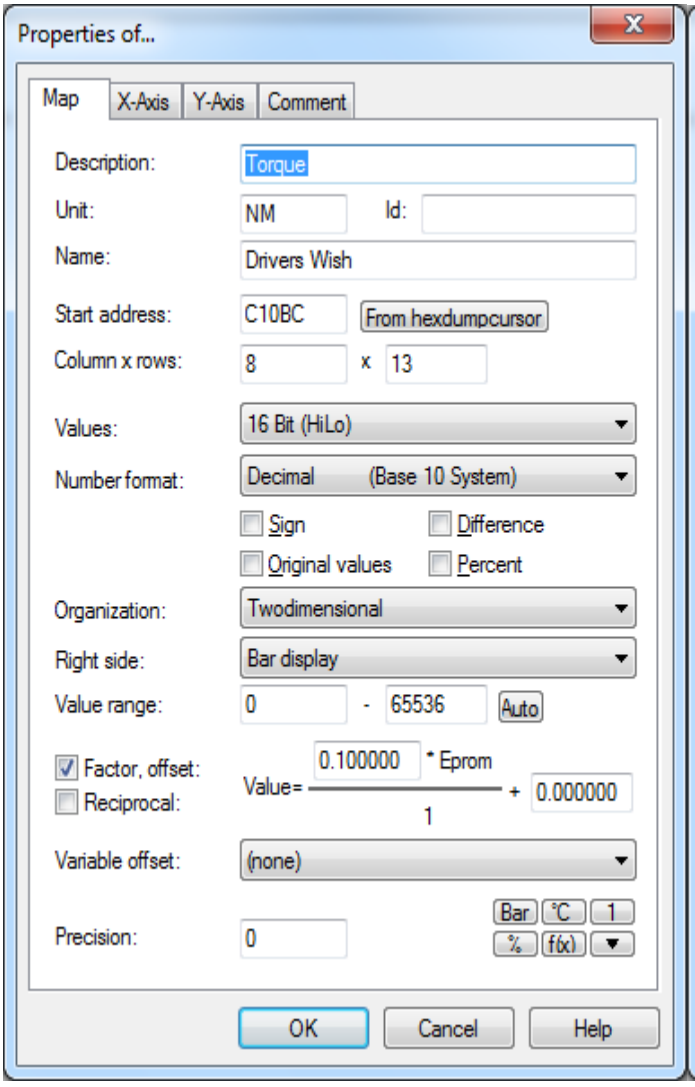
Map address, dimensions and factors

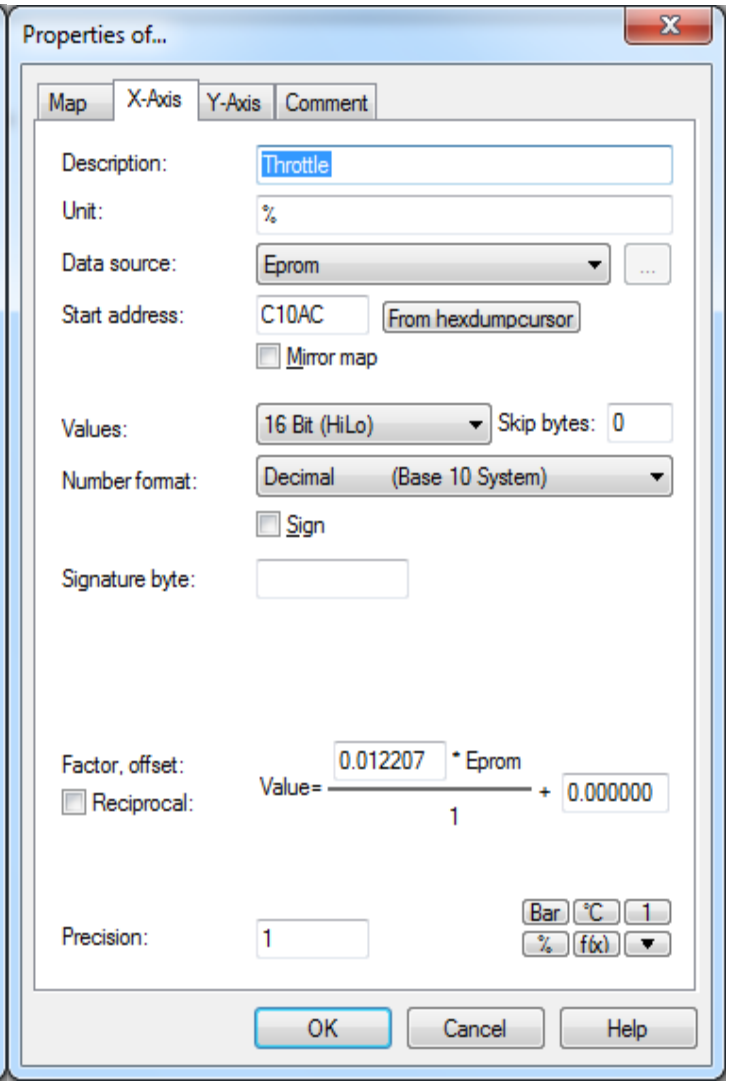
Fuel related maps

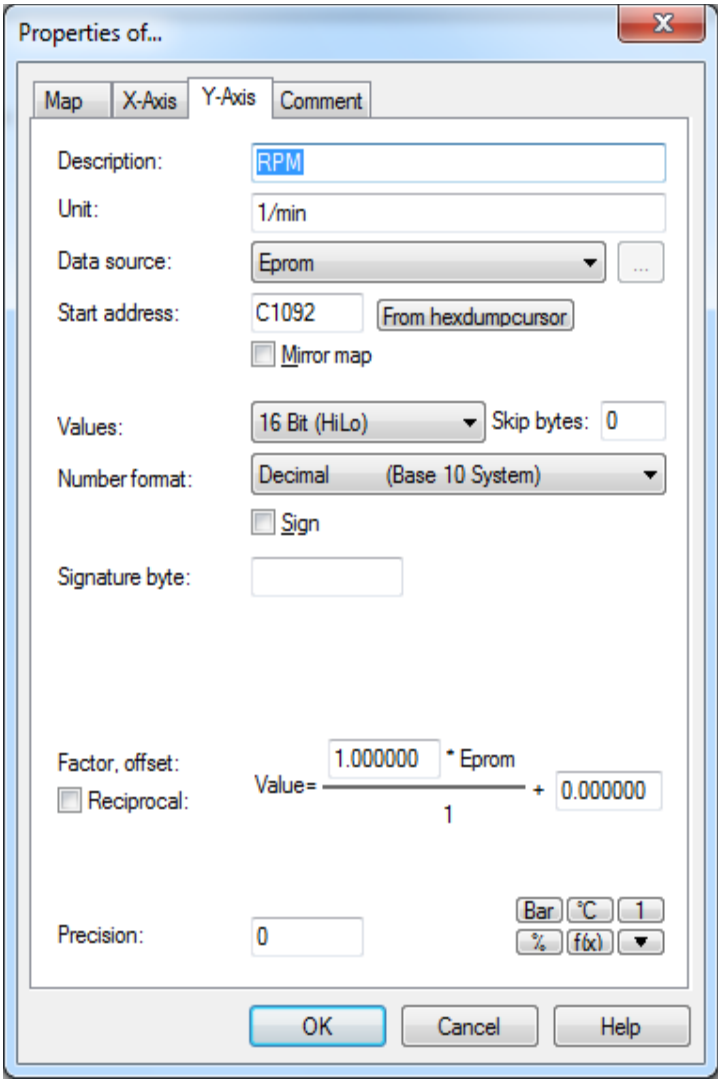
1. **Drivers wish Maps:**

General:

This map shows the required torque based on the RPM and the Throttle position. The output of this map is Torque in Nm. There may be more drivers wish maps, in the file I used for this guide there were 3 drivers wish maps.



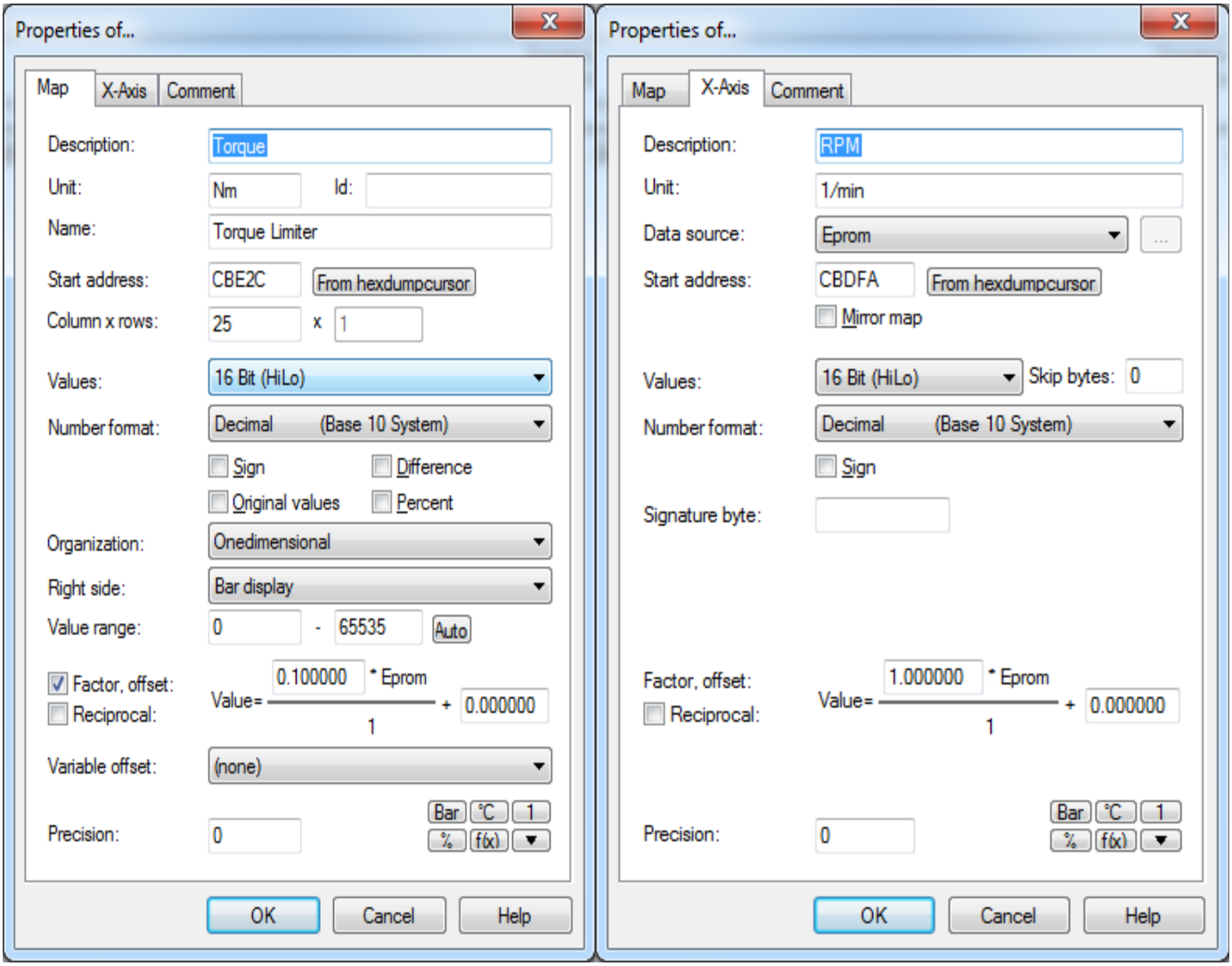



Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
C1092
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

2. **Torque limiter:**

General:

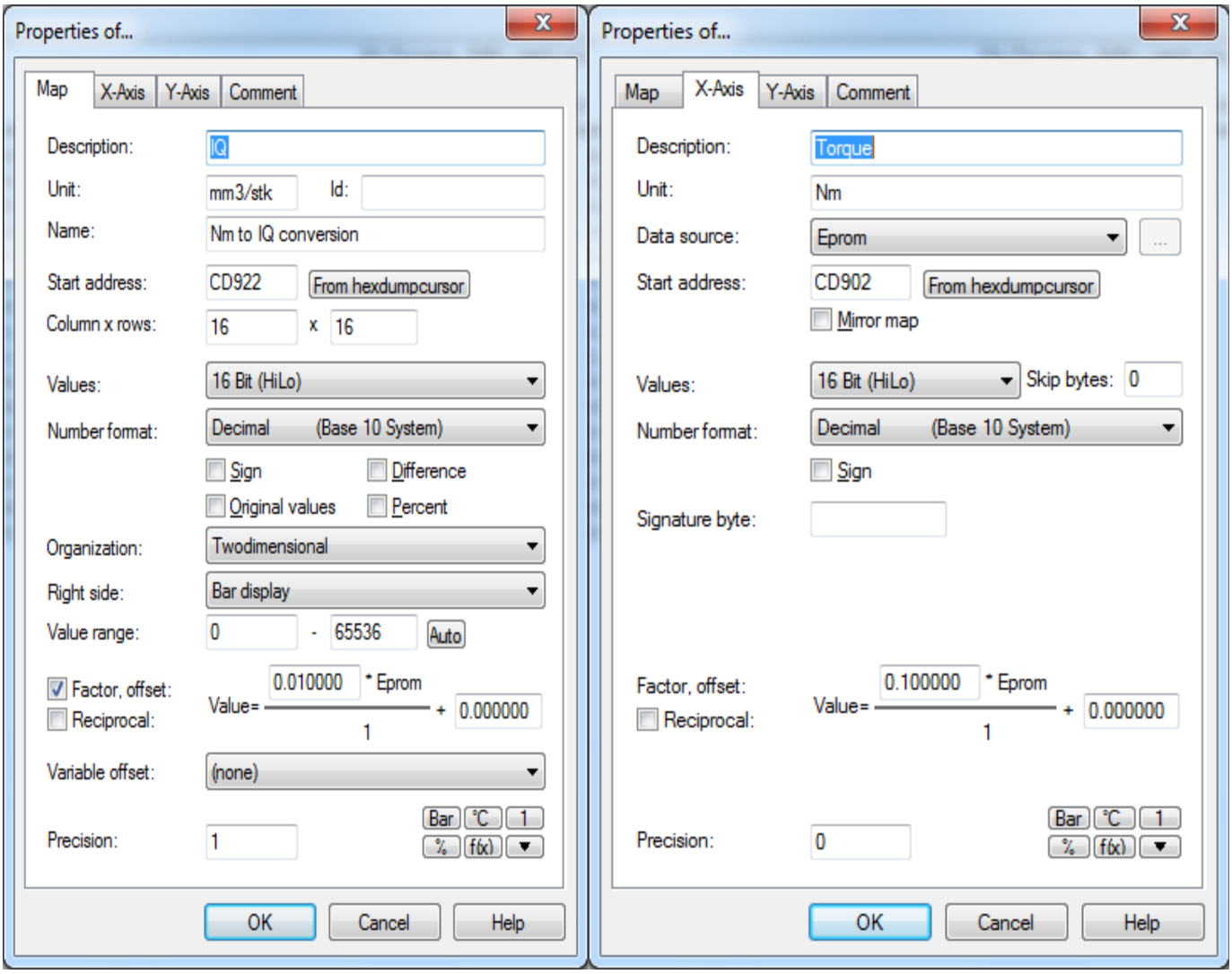
This map limits the torque of the engine based on RPM and atmospheric pressure. The output of this map is also Torque in Nm. This is 2D map.

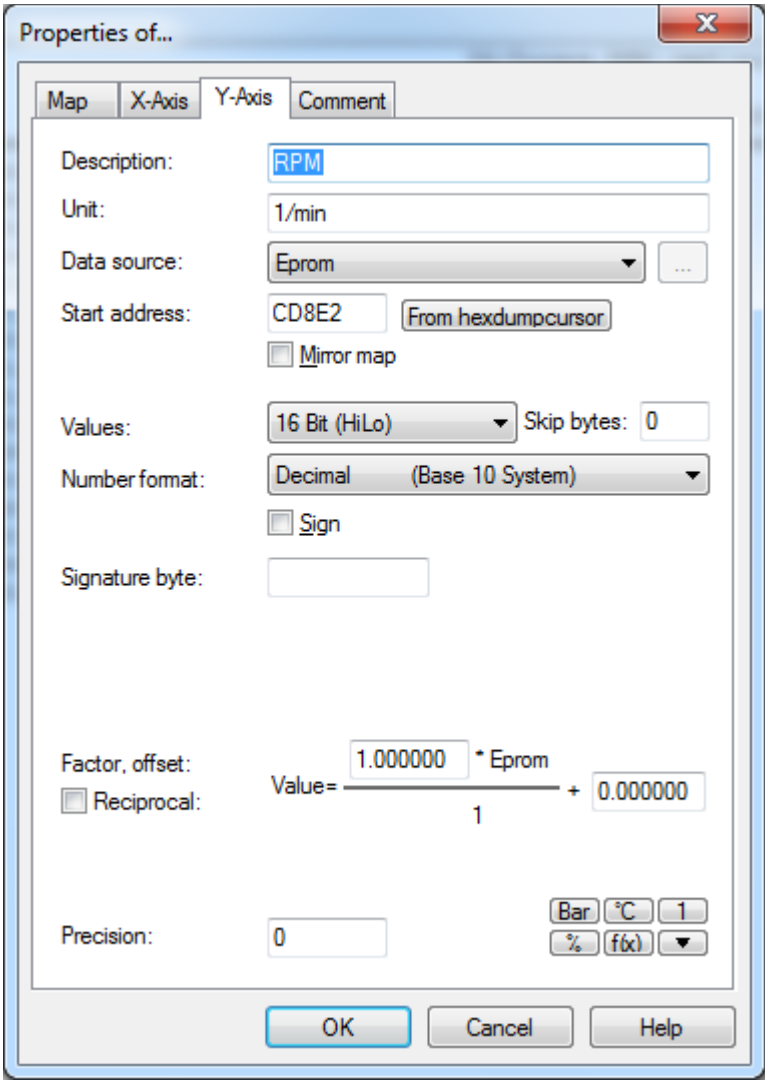


3. Nm to IQ conversion map:

General:

This map is a calibration map. This map converts the requested Torque in Nm into IQ (injected quantity).

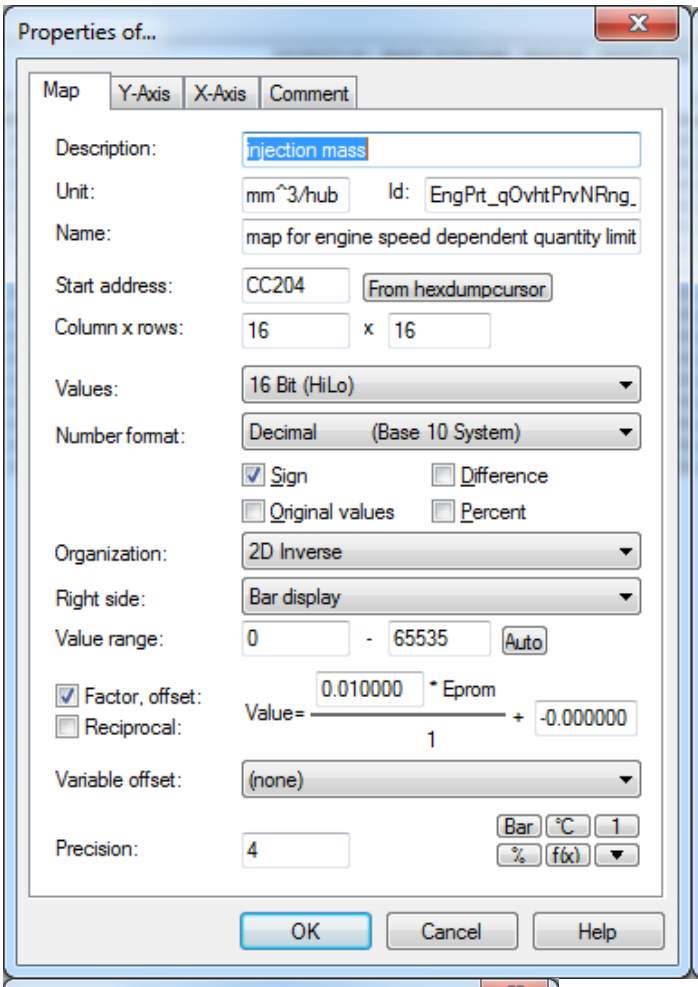


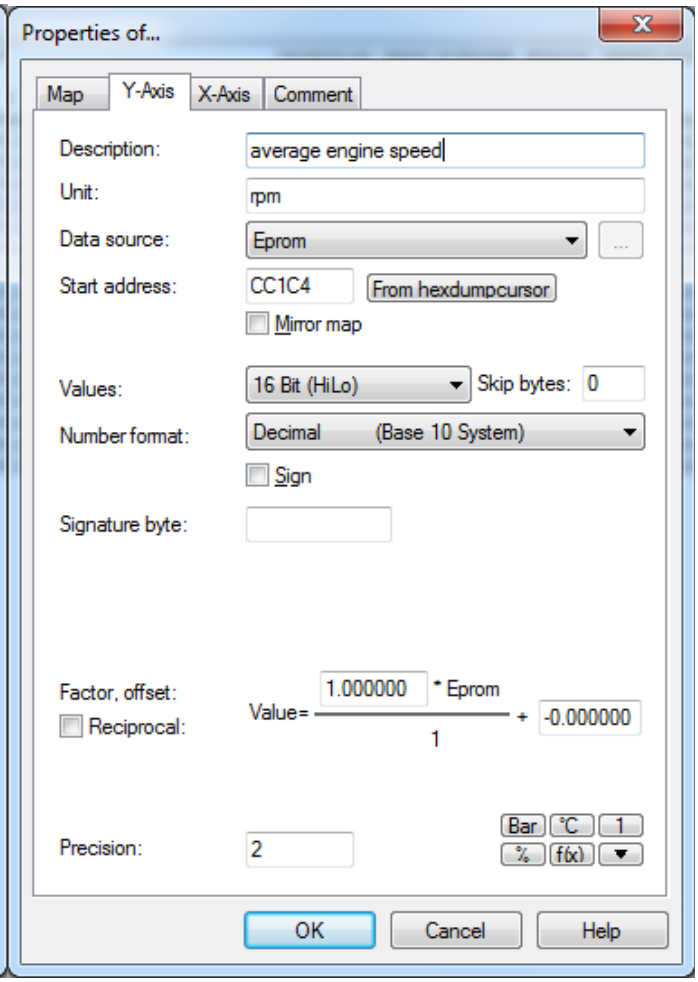

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
CD8E2
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

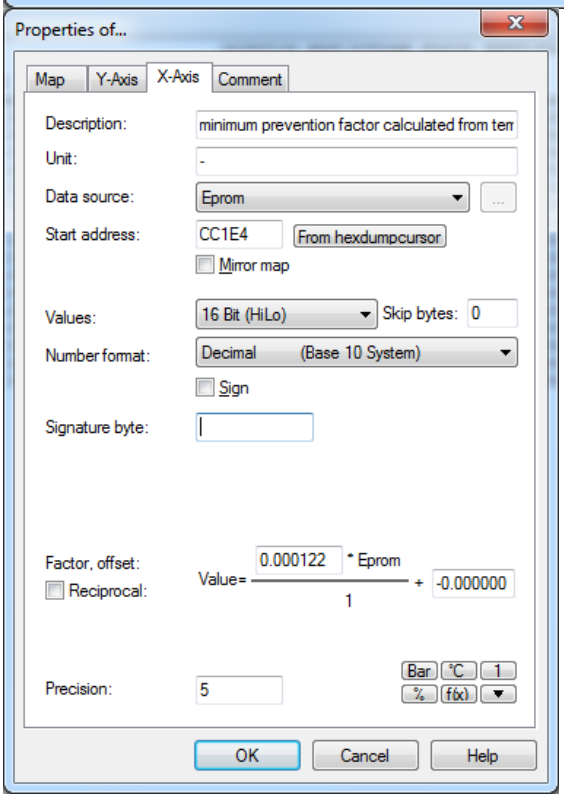
4. IQ limiter map:

General:

This is map for engine speed dependent quantity limitation.







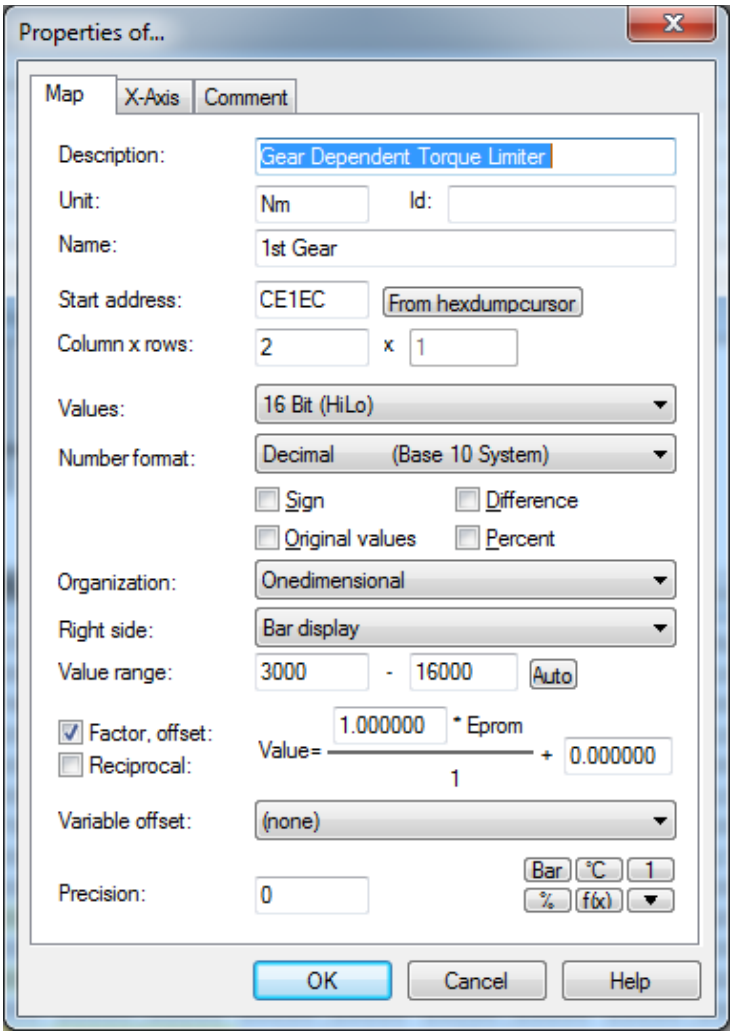
5. Gear Dependent Torque Limiter

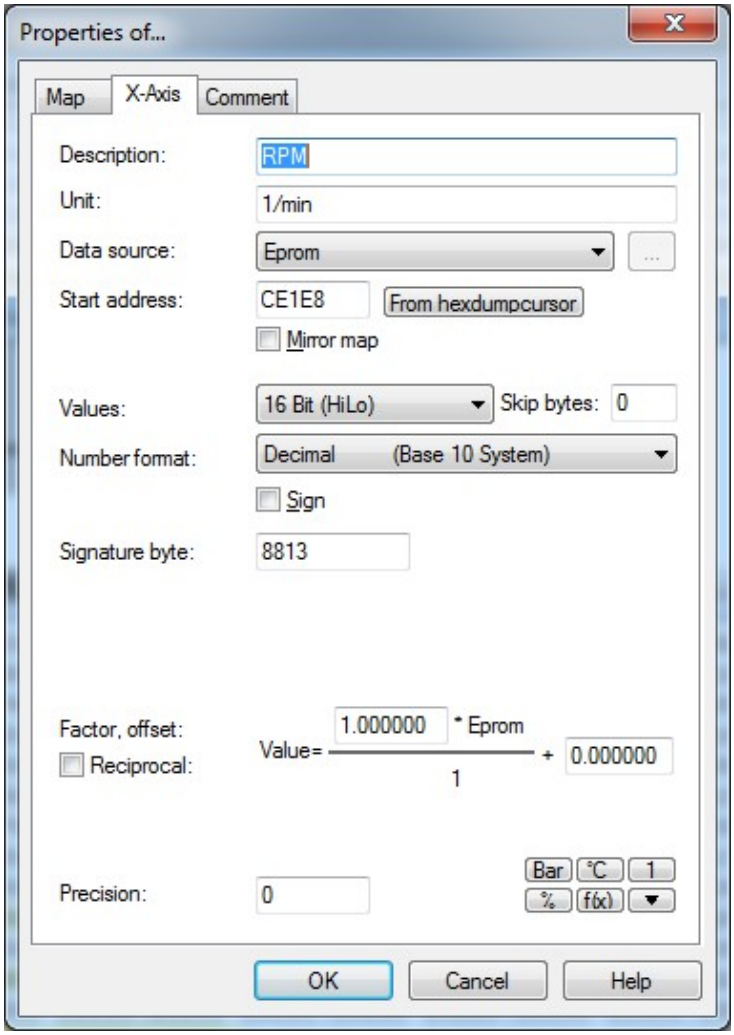
General:

From first to sixth gear and reverse, those map names speak for it. They look like that:

00002 00635 04000 10000 10000

In Opel cars the data after 10000 are unused till the next 00002 then starts the next limiter 2x1.



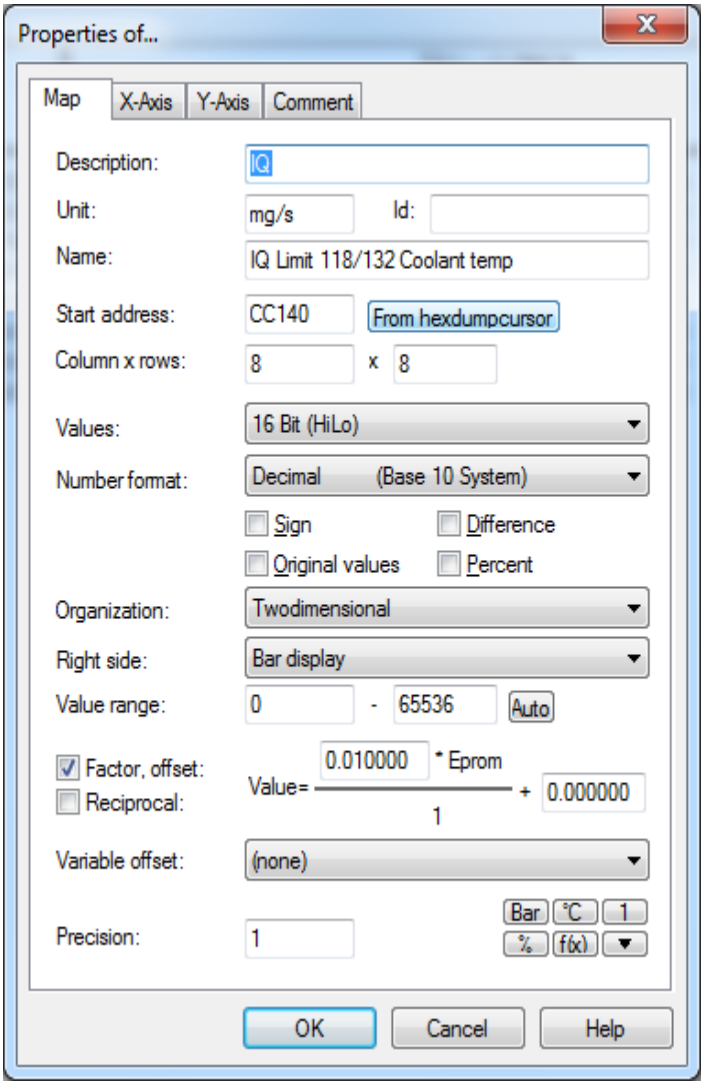


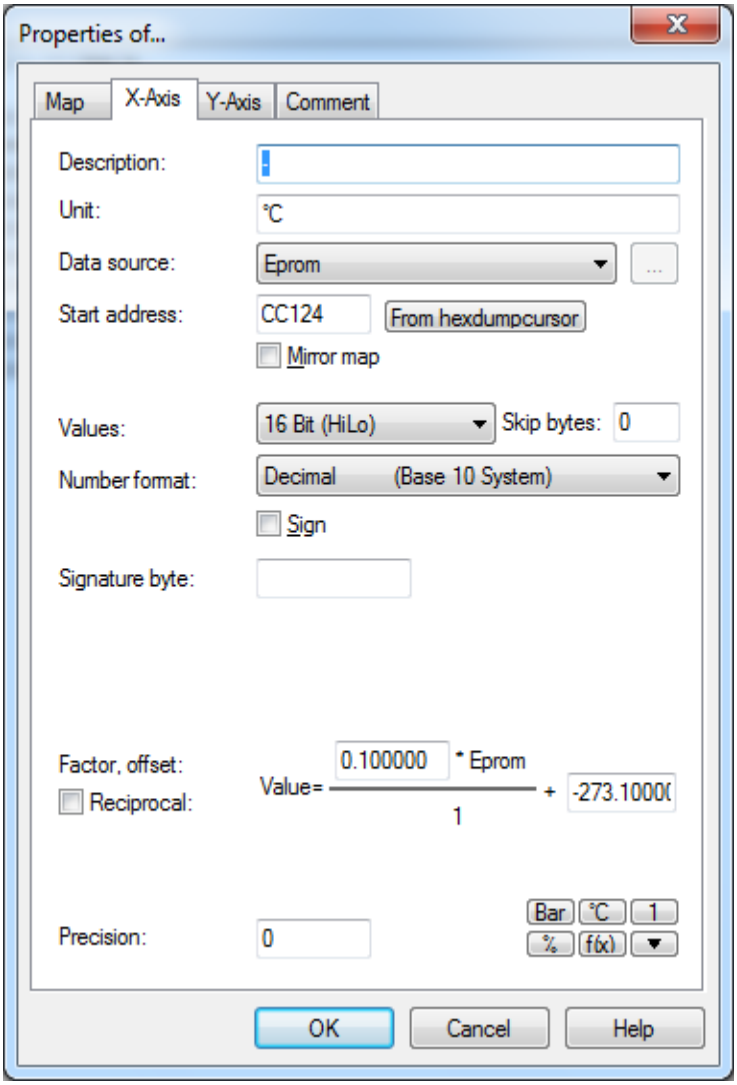
Those maps could start also with value 3000 and depending of the gear have the final value either 1000, 2000, 3000, 4000, 5000, 6000 or 0. Axis has values 01200 01250 01500 01750 02000 02250….(RPMs)

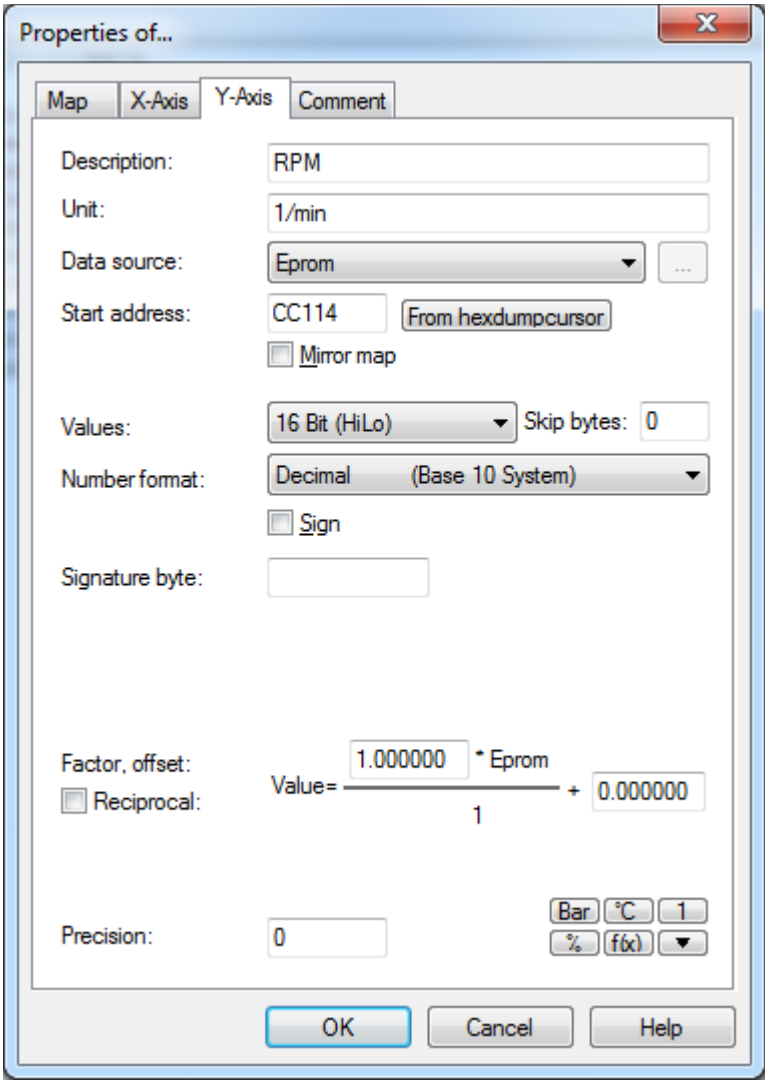
6. IQ limit by Coolant Temperature

General:

This map limits IQ depending of Coolant Temperature.



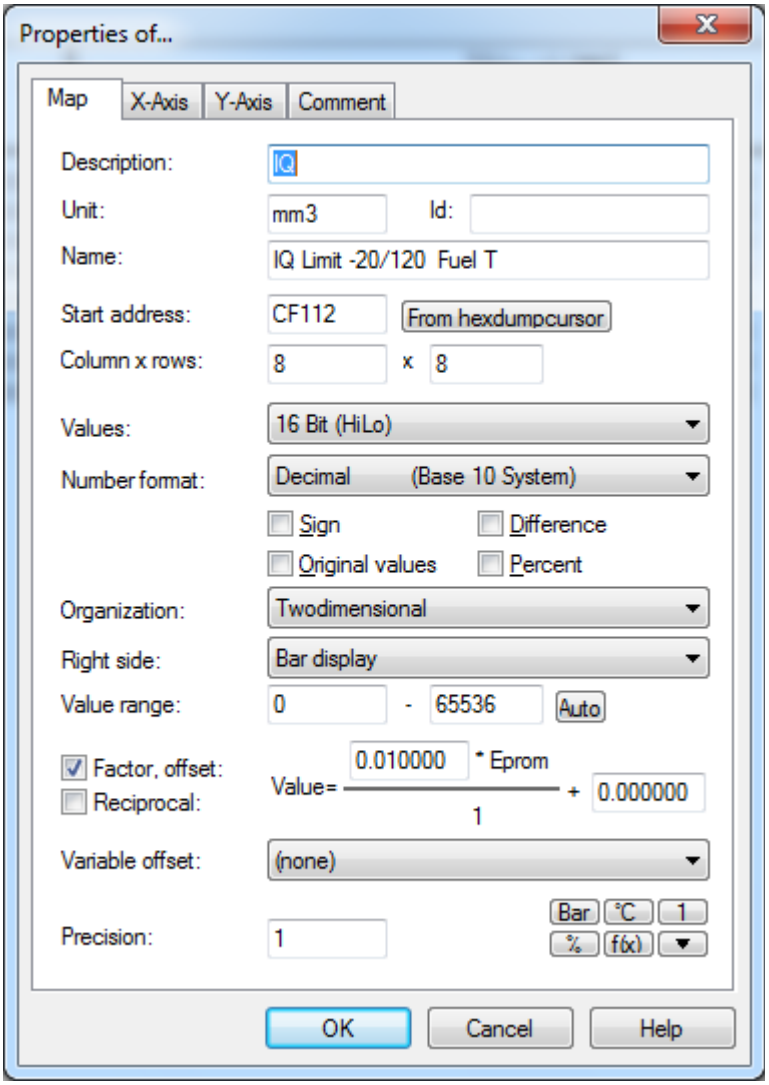


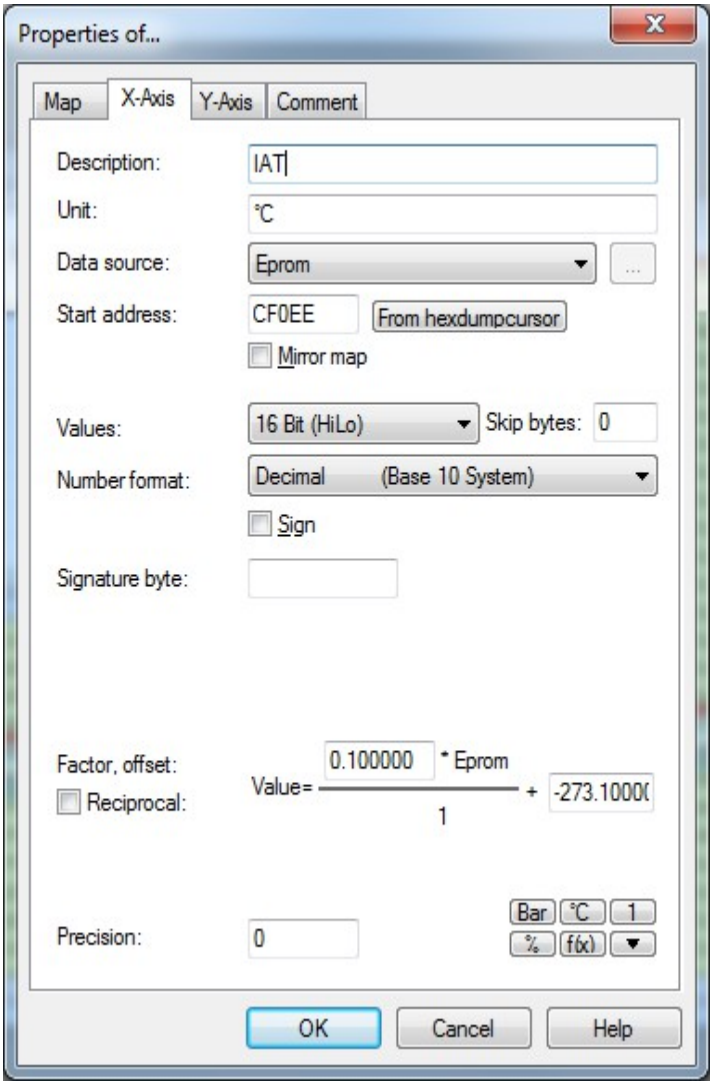

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
CC114
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
Value=
1.000000
* Eprom
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

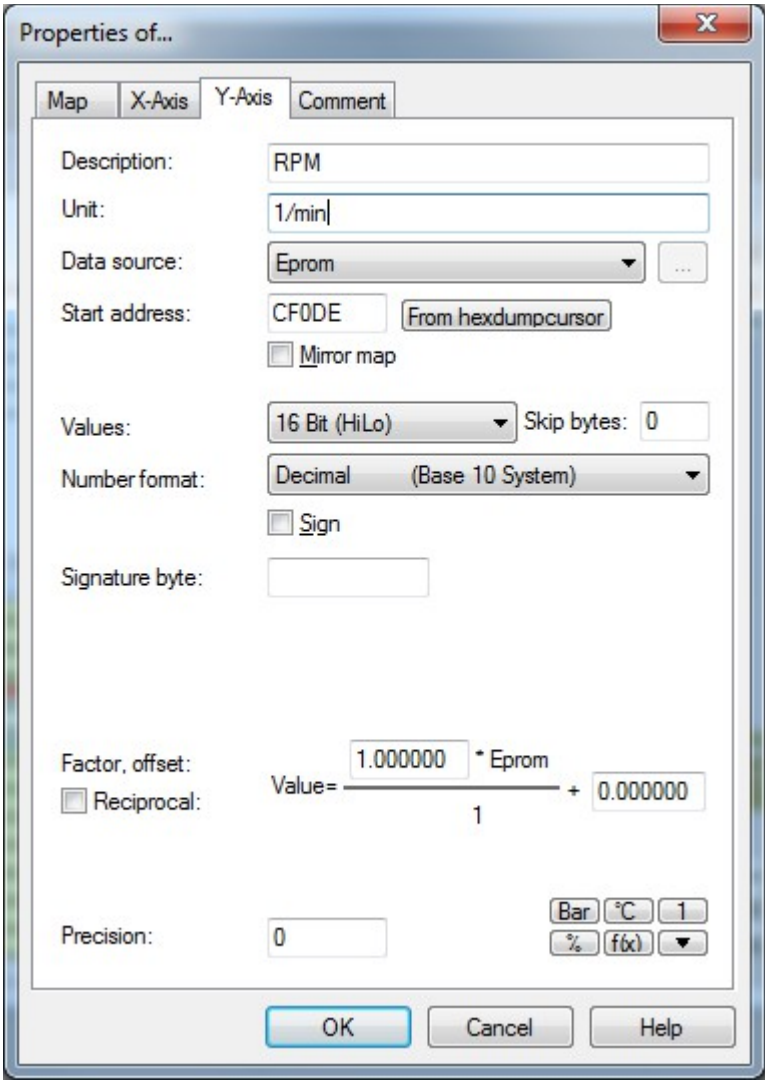
7. IQ limit by Intake Fuel Temperature

General:

This map limits IQ depending of Intake Fuel Temperature.



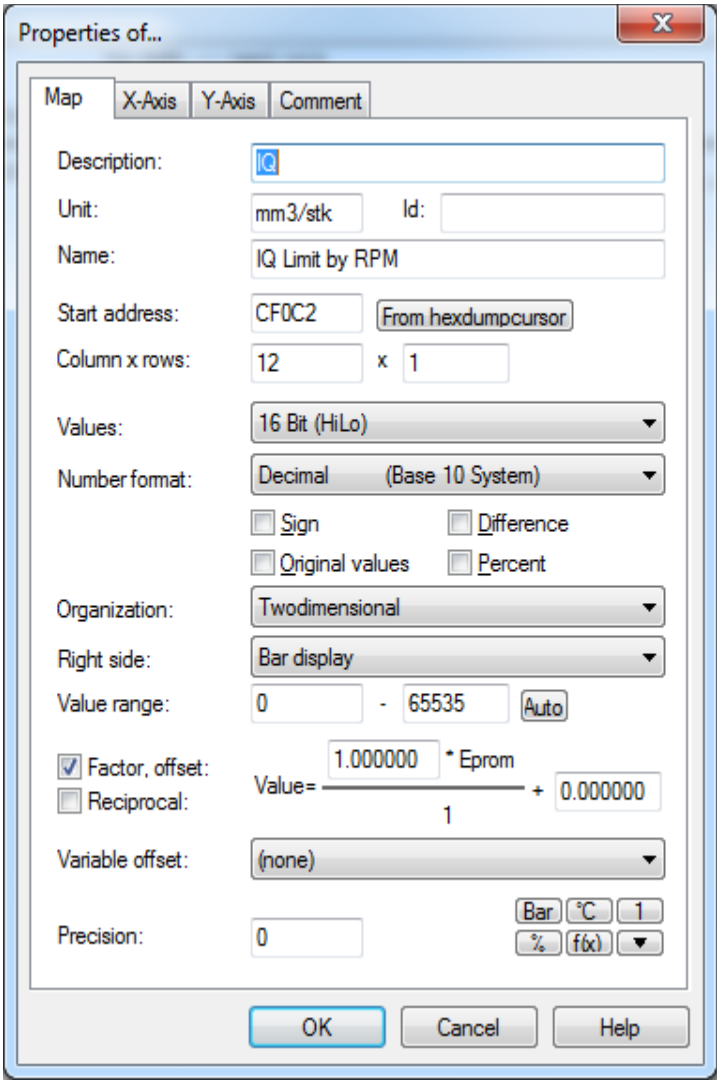


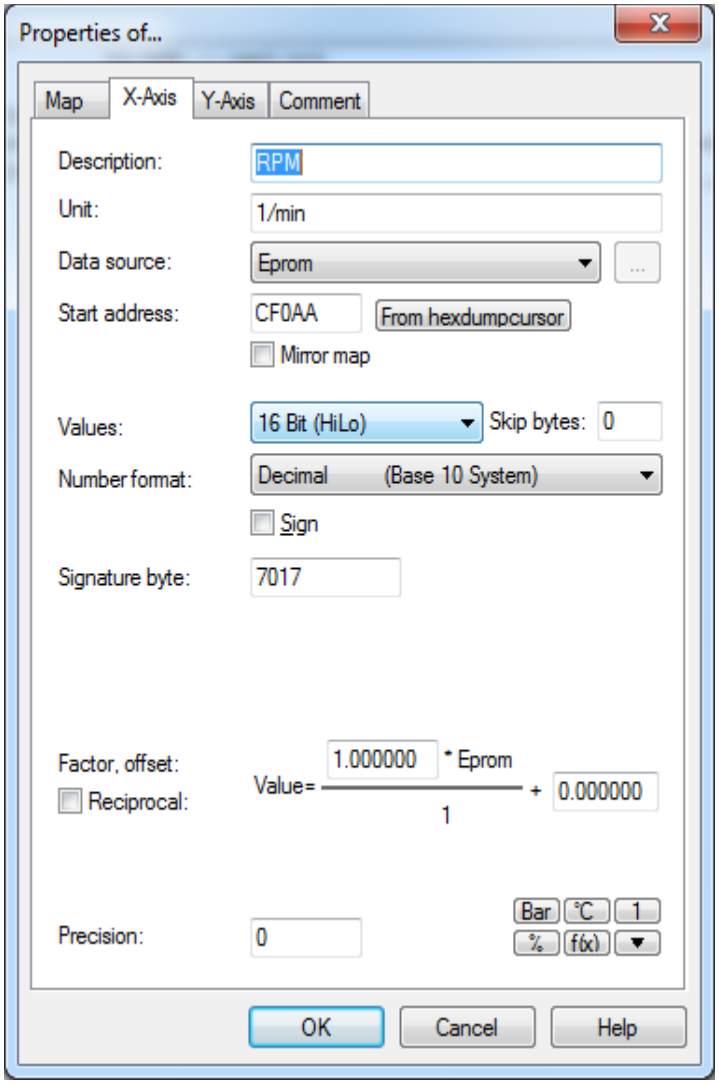

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
CF0DE
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

8. IQ limit by RPM

General:

This map limits IQ depending of Intake Air Temperature.





9. Start Of Injection map(SOI/SOE):

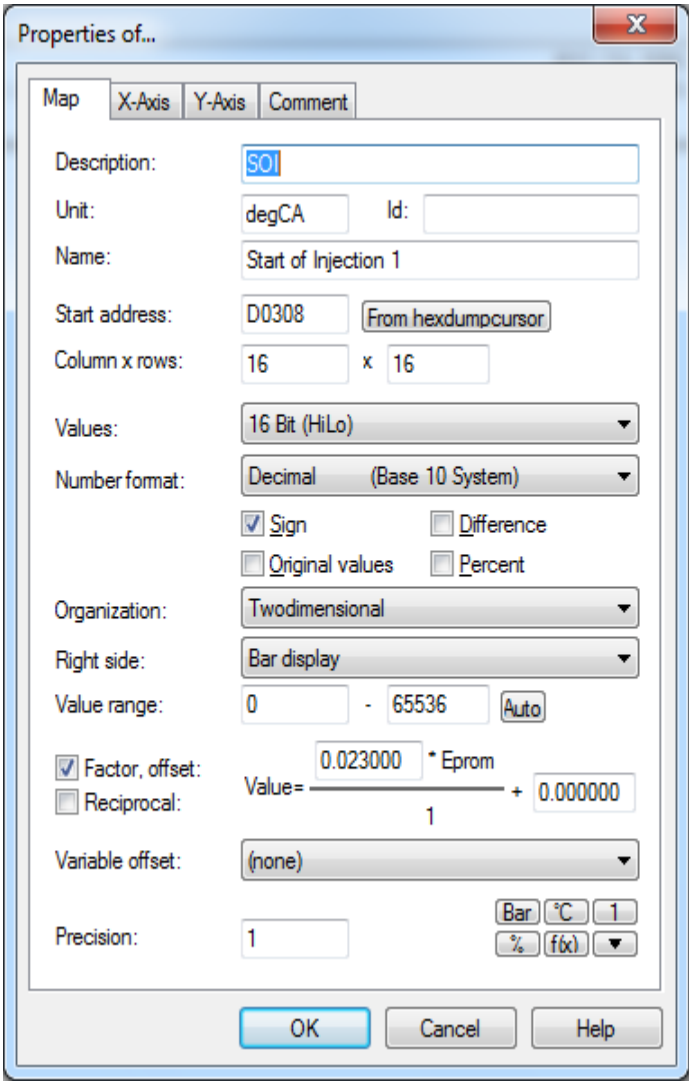
General:

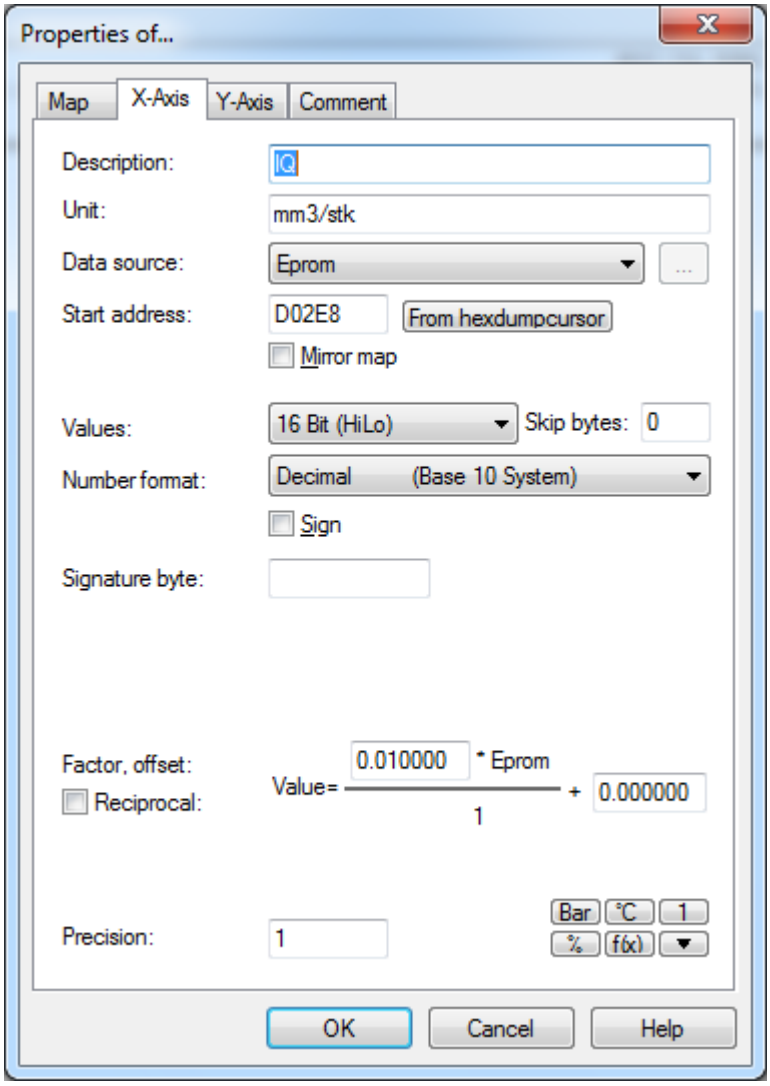
This map shows angle at which start injection against TDC. There is 10 maps, 5 of them are exactly the same and are used during DPF regeneration.

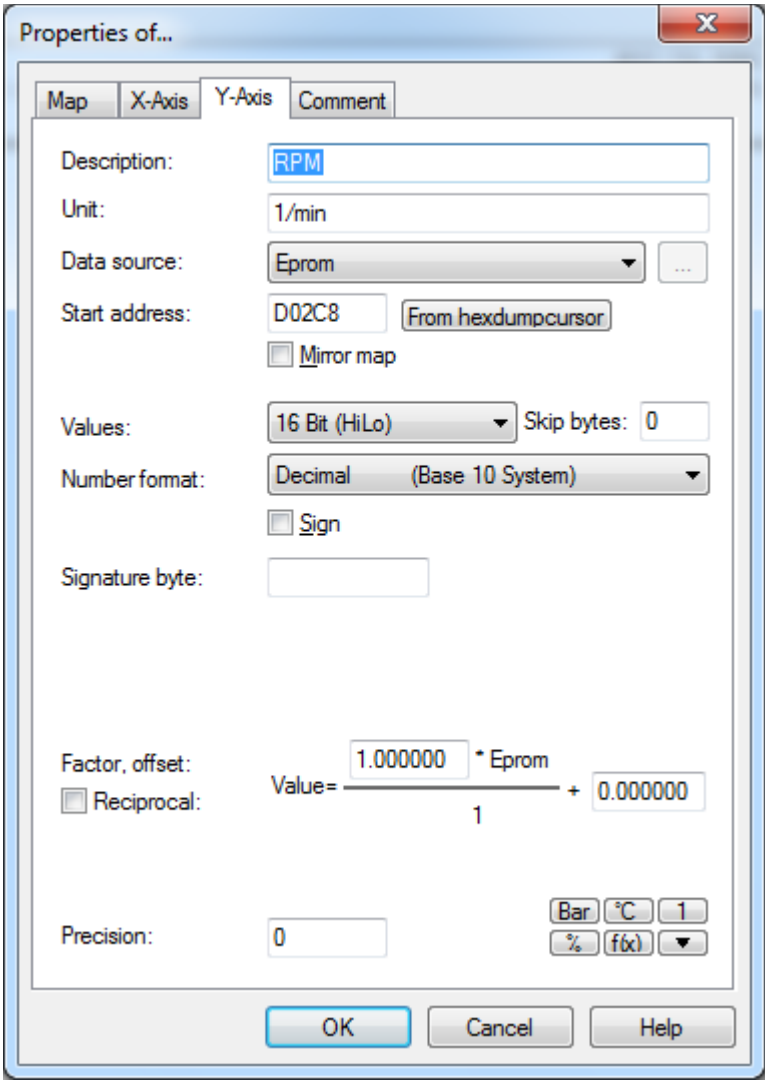
Start of Energising of Pilot Injections

The structure of SOE calculation is nearly identical between PiI1 and PiI2. The difference can be found in their base. PiI1is calculated relative to SOE of MI of the last injection cycle, while PII2 is calculated relative to PiI1 of the same cycle. The calculation is based on some limits that must not be exceeded in a running system.

Pilot injections are always calculated relative to main injection, but their earliest SOE InjCrv_phiPiIMax_C is implicated relative to TDC (namely 30deg BTDC for our cars, and it's a map close after SOE).



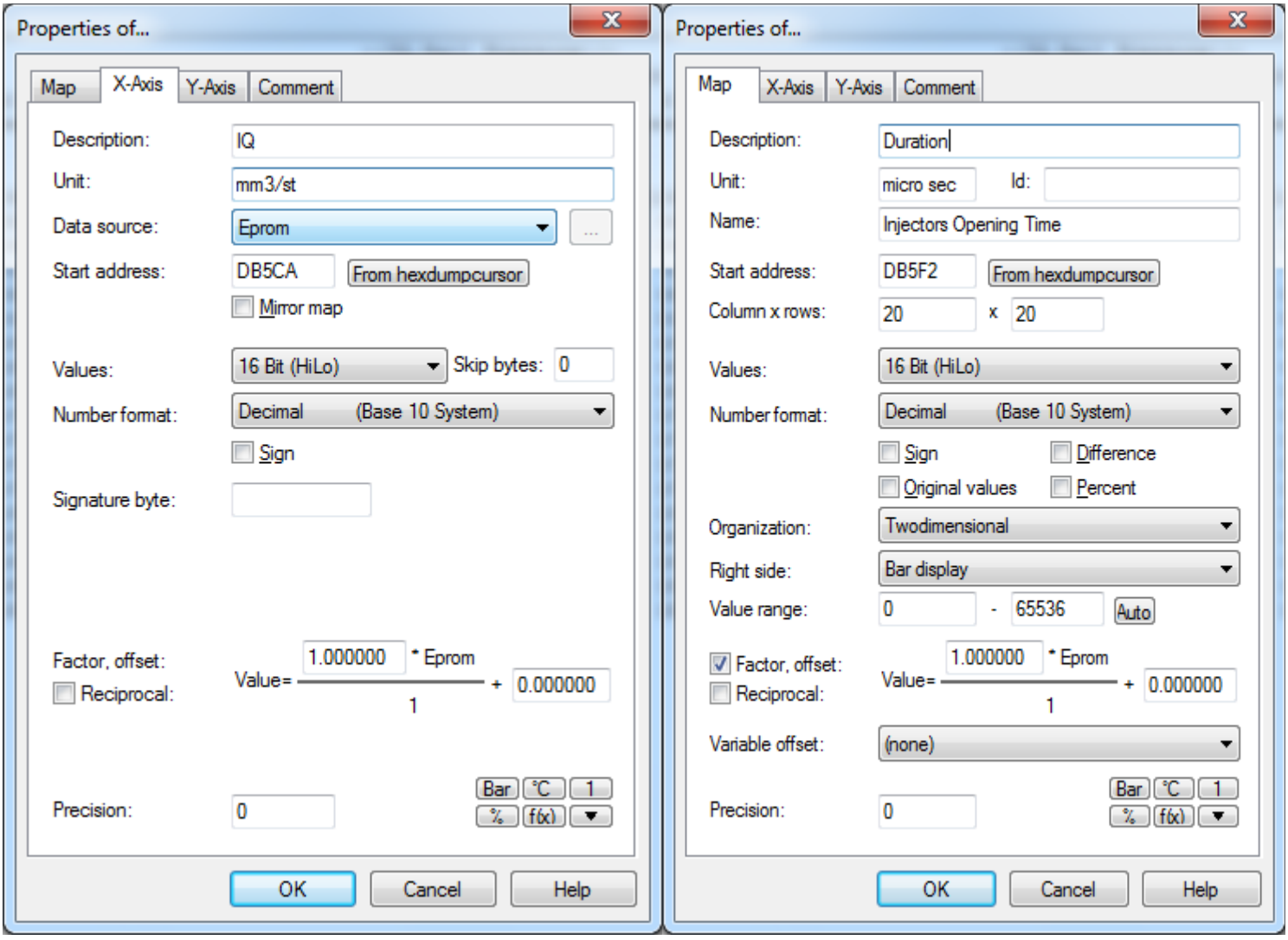


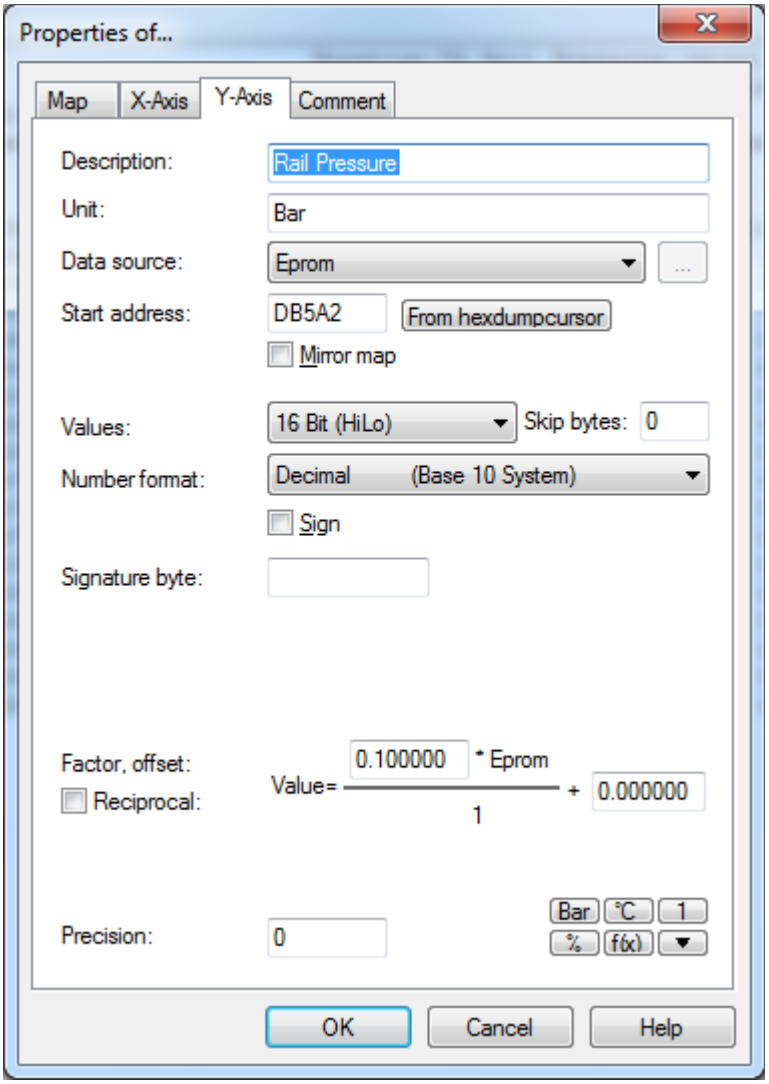

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
D02C8
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
Value=
1.000000
* Eprom
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

10. Injector opening time (Duration map):

General:

This map is a calibration map. This map shows how much rotation it takes to achieve the required amount of fuel injected. The output of this map is in engine degrees.

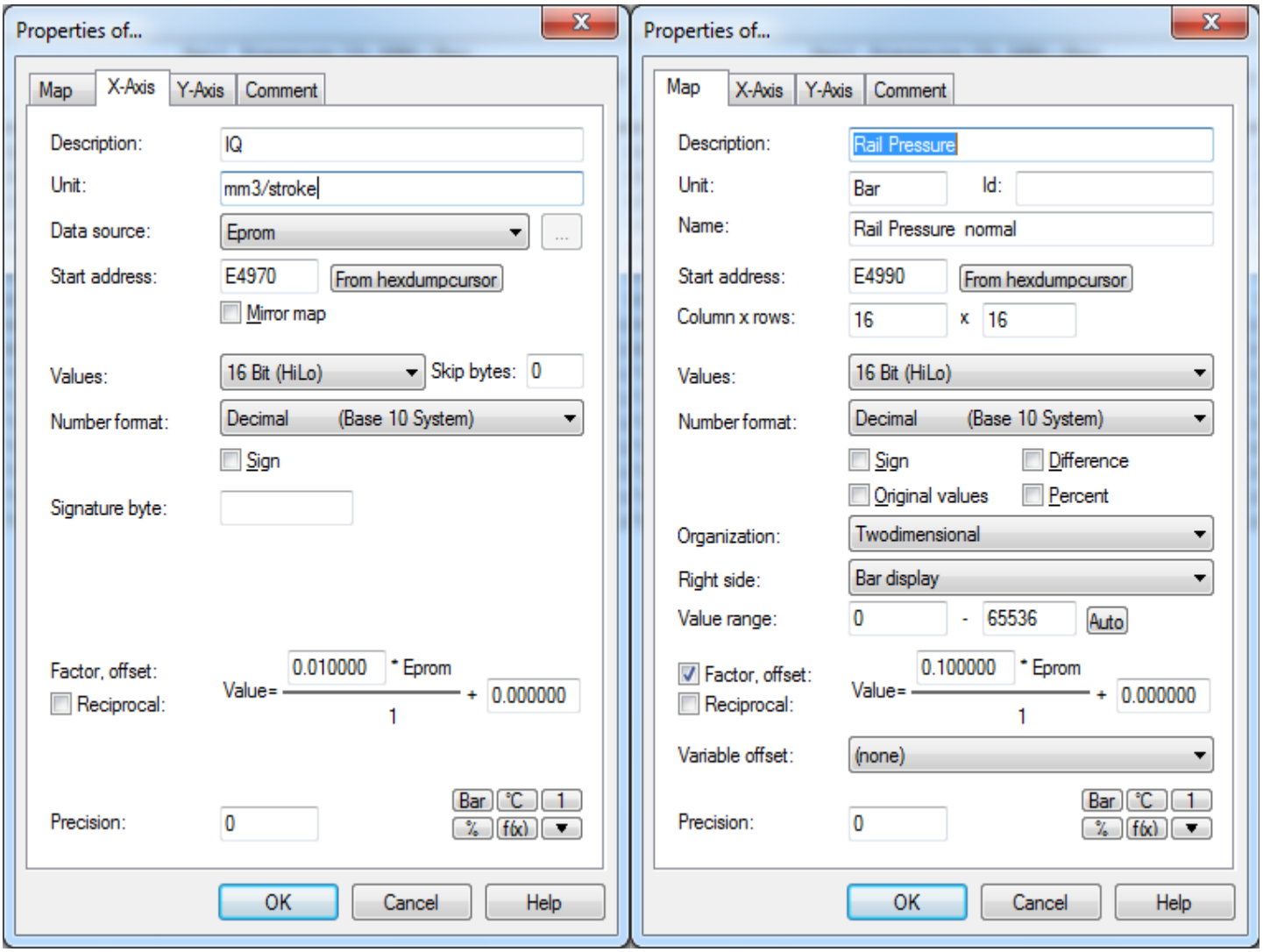


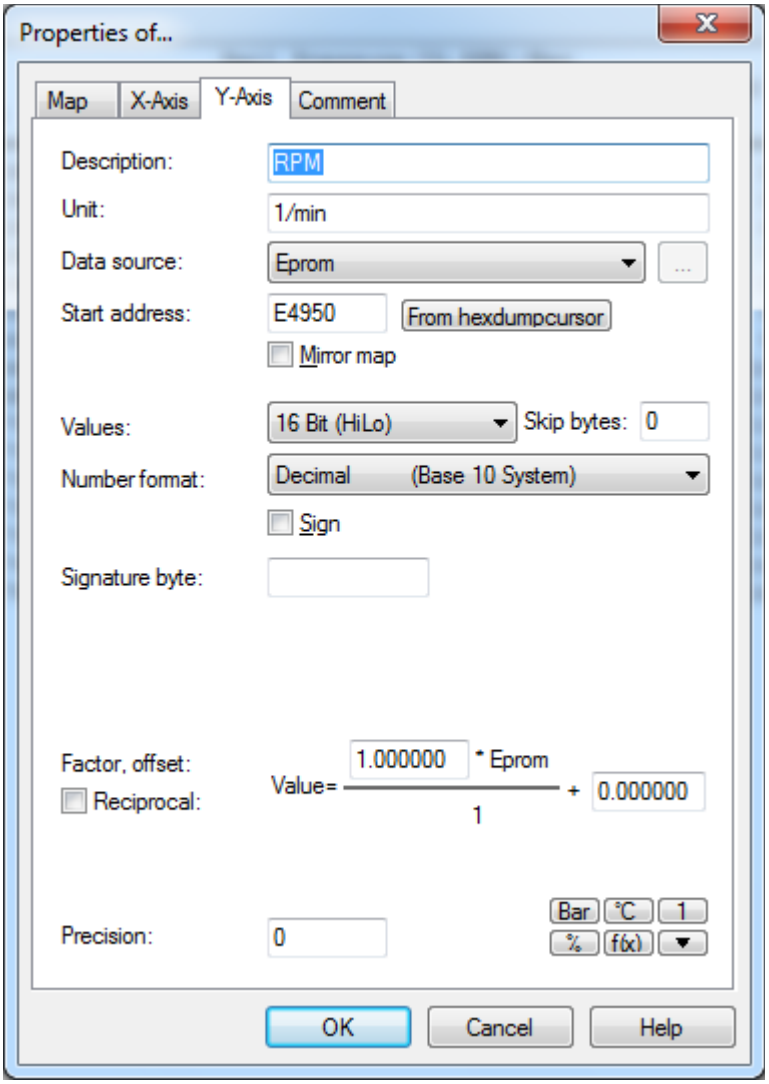

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
Rail Pressure
Unit:
Bar
Data source:
Eprom
Start address:
DB5A2
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
0.100000
* Eprom
Value=
+
0.000000
1
Reciprocal:
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

11. CRS Rail Pressure:

General:

This map shows how should be the rail pressure at certain RPM and IQ. There is 2 maps, 1st is used during DPF regeneration, 2nd during normal operation.

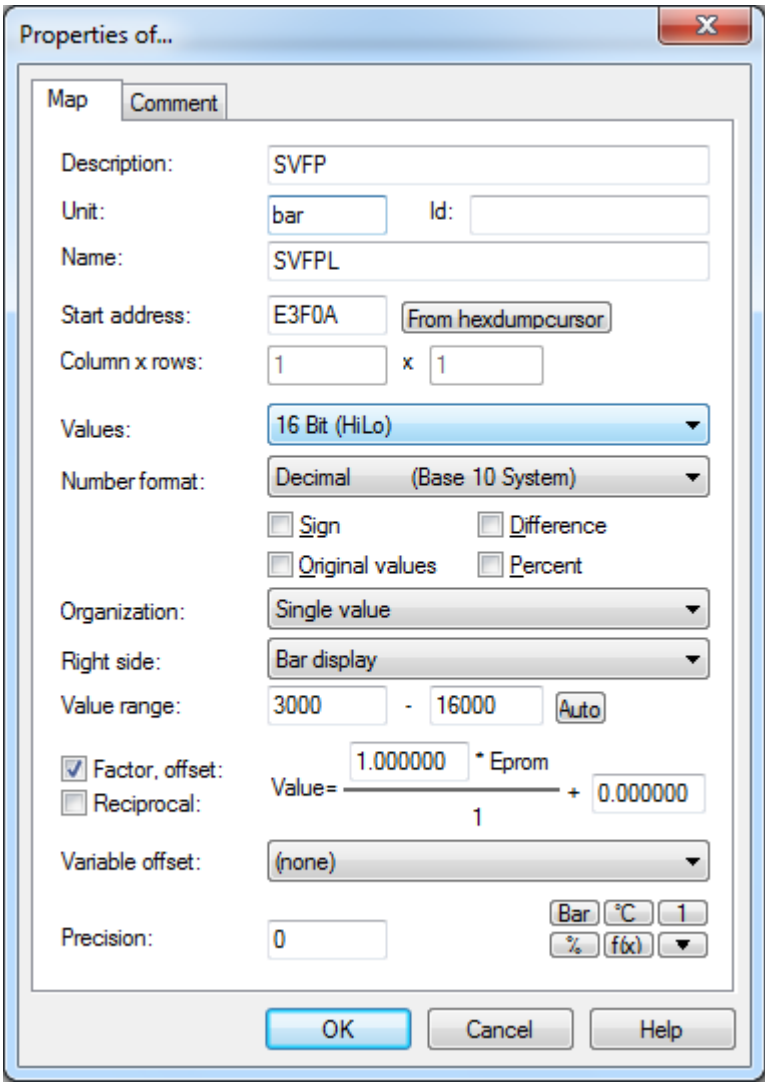



Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
E4950
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
Value=
1.000000
* Eprom
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

12. SV Rail Pressure:

General:

This value limits the absolute common rail pressure. This value can be found behind the rail pressure map. There is 4 maps.

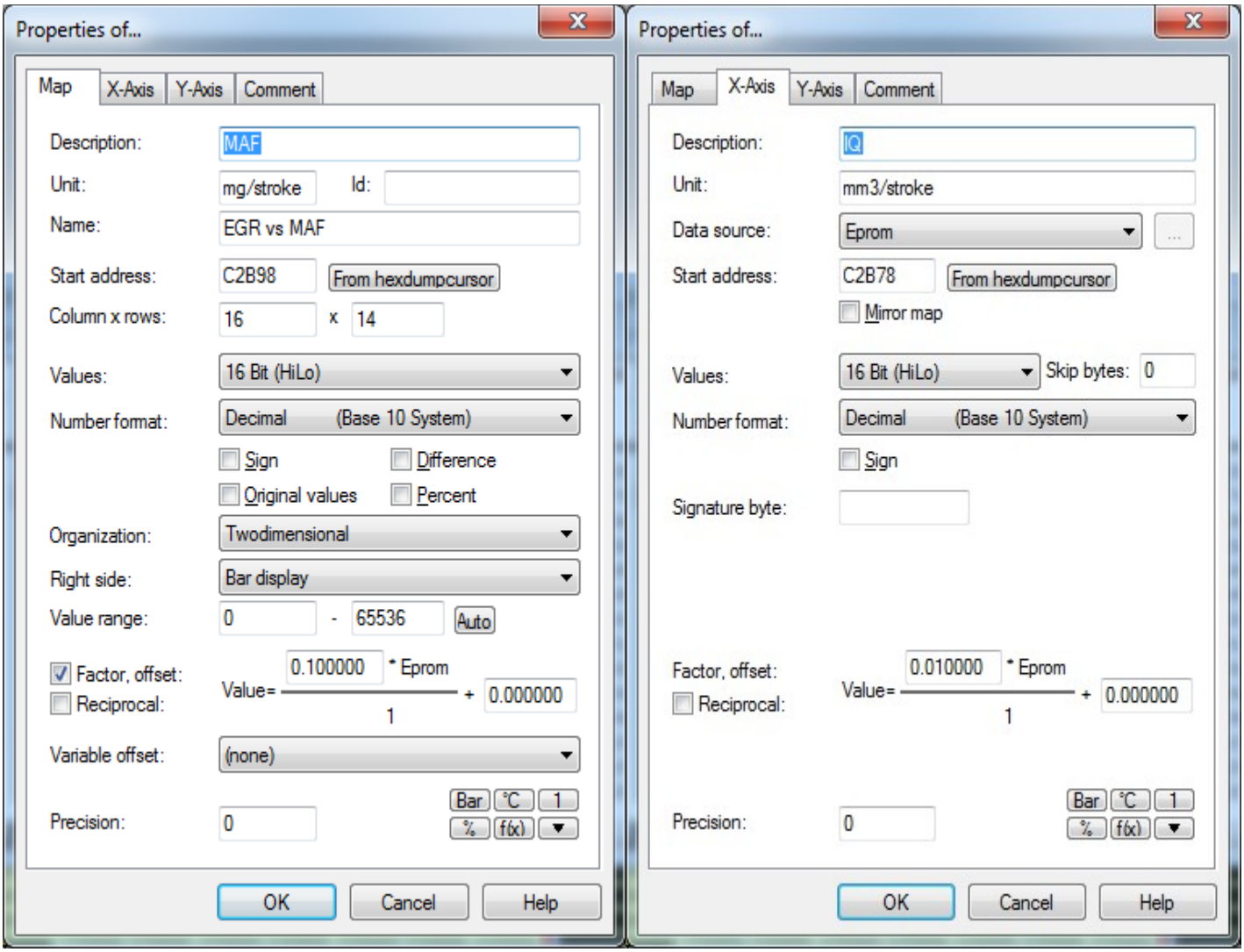


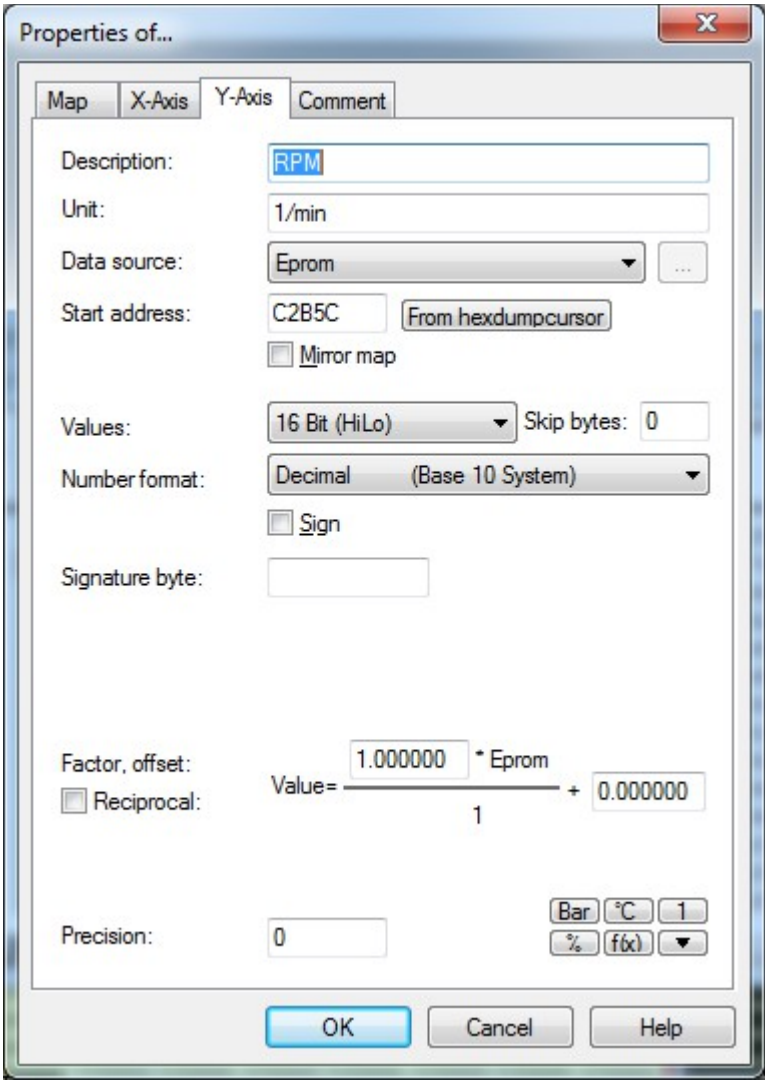
Air related maps

13. EGR vs MAF map:

General:

This map regulates the Exhaust gas recirculation valve to limit intake MAF.




Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
C2B5C
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

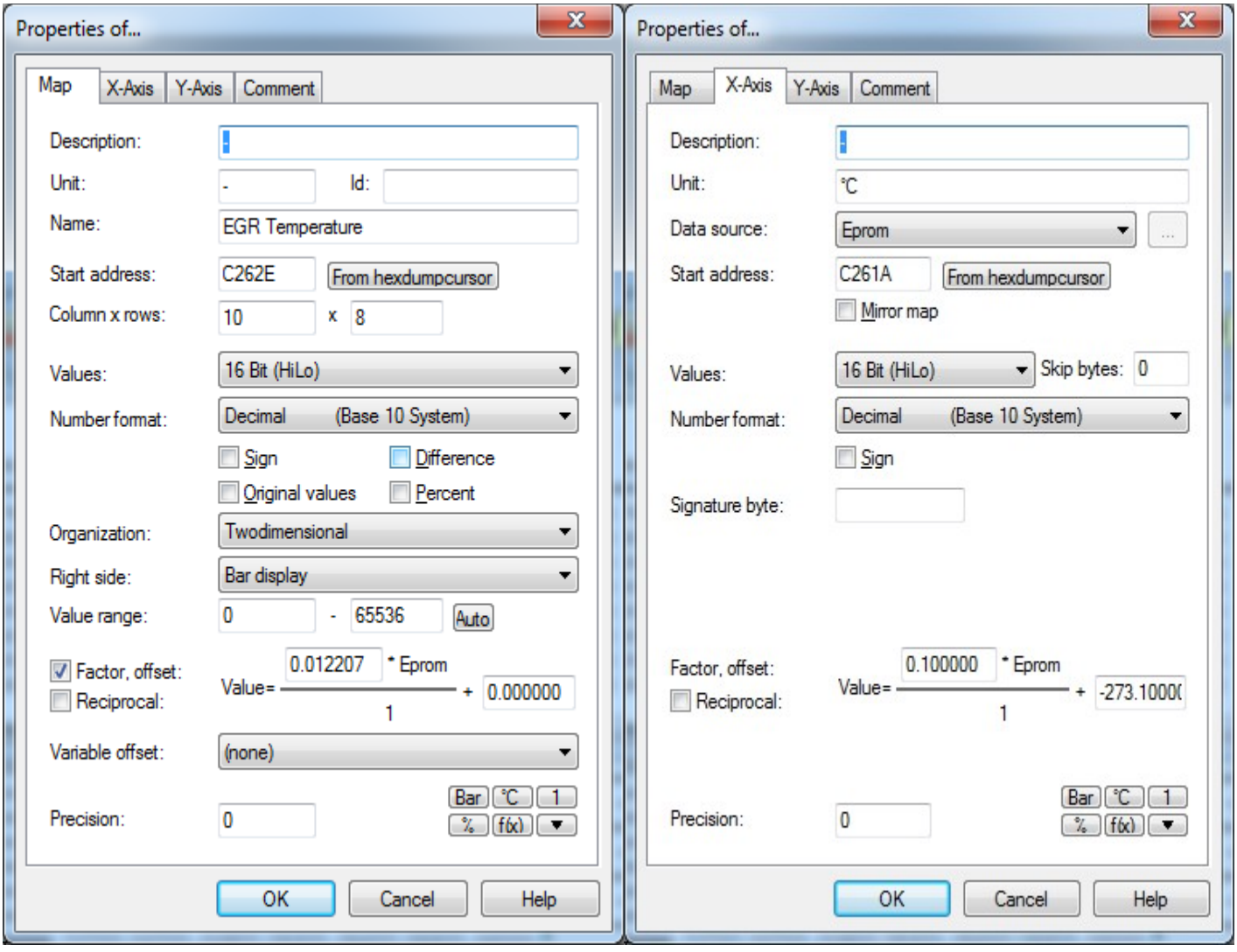
14. EGR vs Temp map (Setpoint generation):

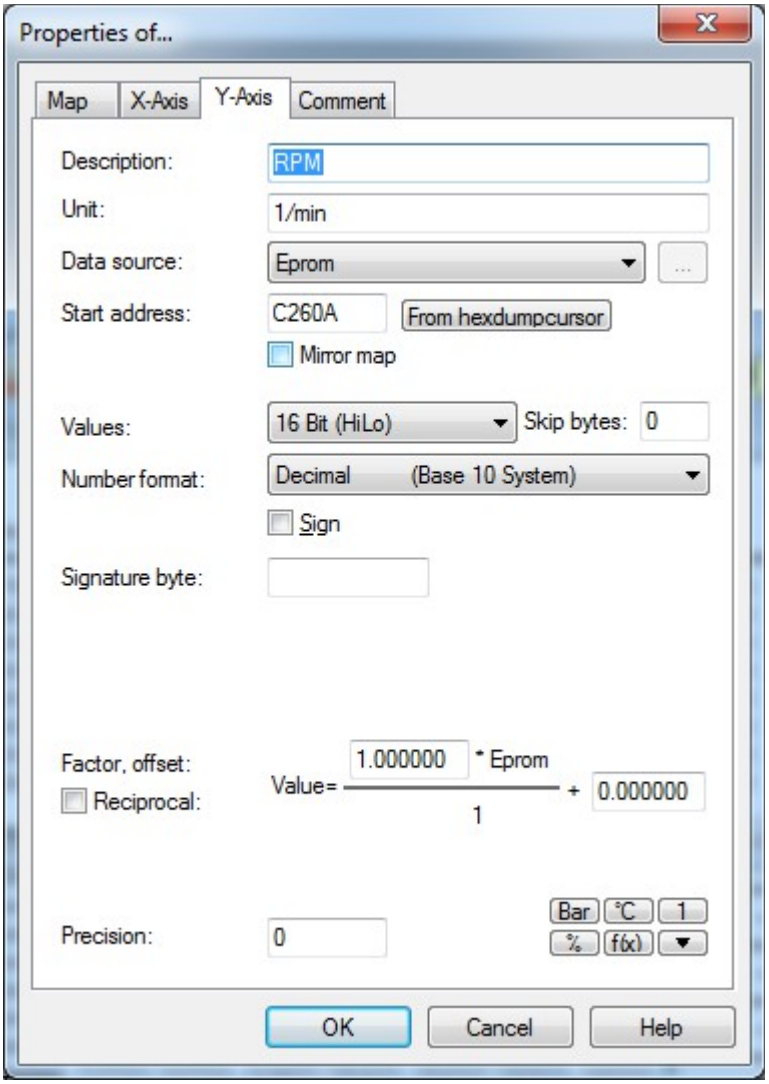
General:

There is several maps for EGR ambient condition correction.

For stationary reference, first the underlying AirCtl_mDesBase_mp from the target map AirCtl_mDesBase_MAP in function of the speed and the unlimited Eng_nAvrg injection quantity InjCtl_qRaw formed. Underlying this is a function of EGR and-balance, atmospheric pressure and temperature corrected by the cooling water temperature. Each of the corrections than the cooling water temperature correction can additively or multiplicative done.

Depending on the intake air temperature is determined with the IATSCD_tAir characteristic AirCtl_ATCor_CUR a factor with one of the characteristic field of the speed AirCtl_NQATCor_MAP Eng_nAvrg and the injection quantity InjCtl_qRaw dependent factor is multiplied and the results Ansauglufttemperaturkorrekturwert. The correction value is dependent of the DAMOS switch AirCtl_swtATCorVal_C considered additive or multiplicative. Thus we obtain the desired value AirCtl_mDesVal_3_mp. A change of the switch requires a new AirCtl_swtATCorVal_C DAMOS run because, the conversions change.



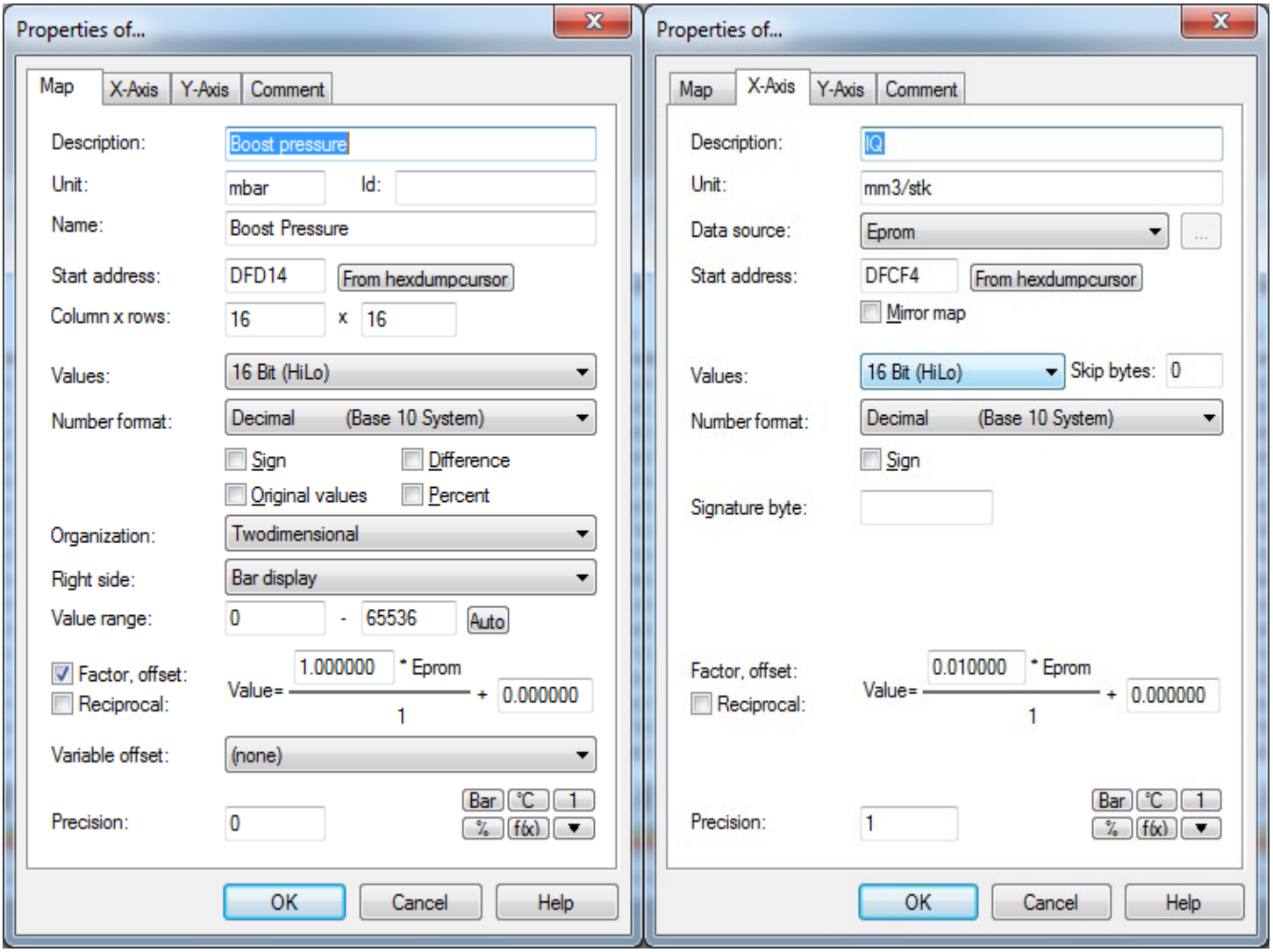

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
C260A
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

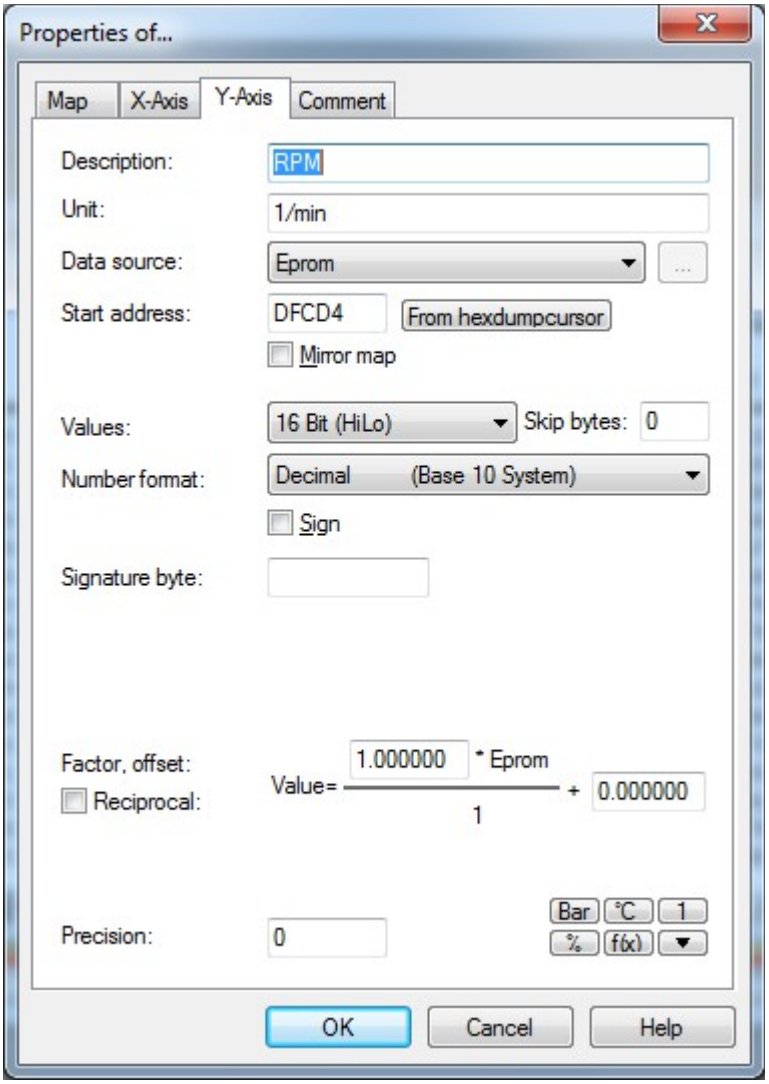
15. Turbo (Boost request) map:

General:

This map set the required boost depending on the requested torque and current rpm. There might be more than one boost map. In this file there is 2 maps, 1st is used during DPF regeneration, 2nd during normal operation. Boost request is measured in Absolute pressure (Bara, mBara, ect.)

- **Absolute pressure** is zero-referenced against a perfect vacuum, so it is equal to gauge pressure plus atmospheric pressure.
- **Gauge pressure** is zero-referenced against ambient air pressure, so it is equal to absolute pressure minus atmospheric pressure. Negative signs are usually omitted. To distinguish a negative pressure, the value may be appended with the word "vacuum" or the gauge may be labeled a "vacuum gauge."

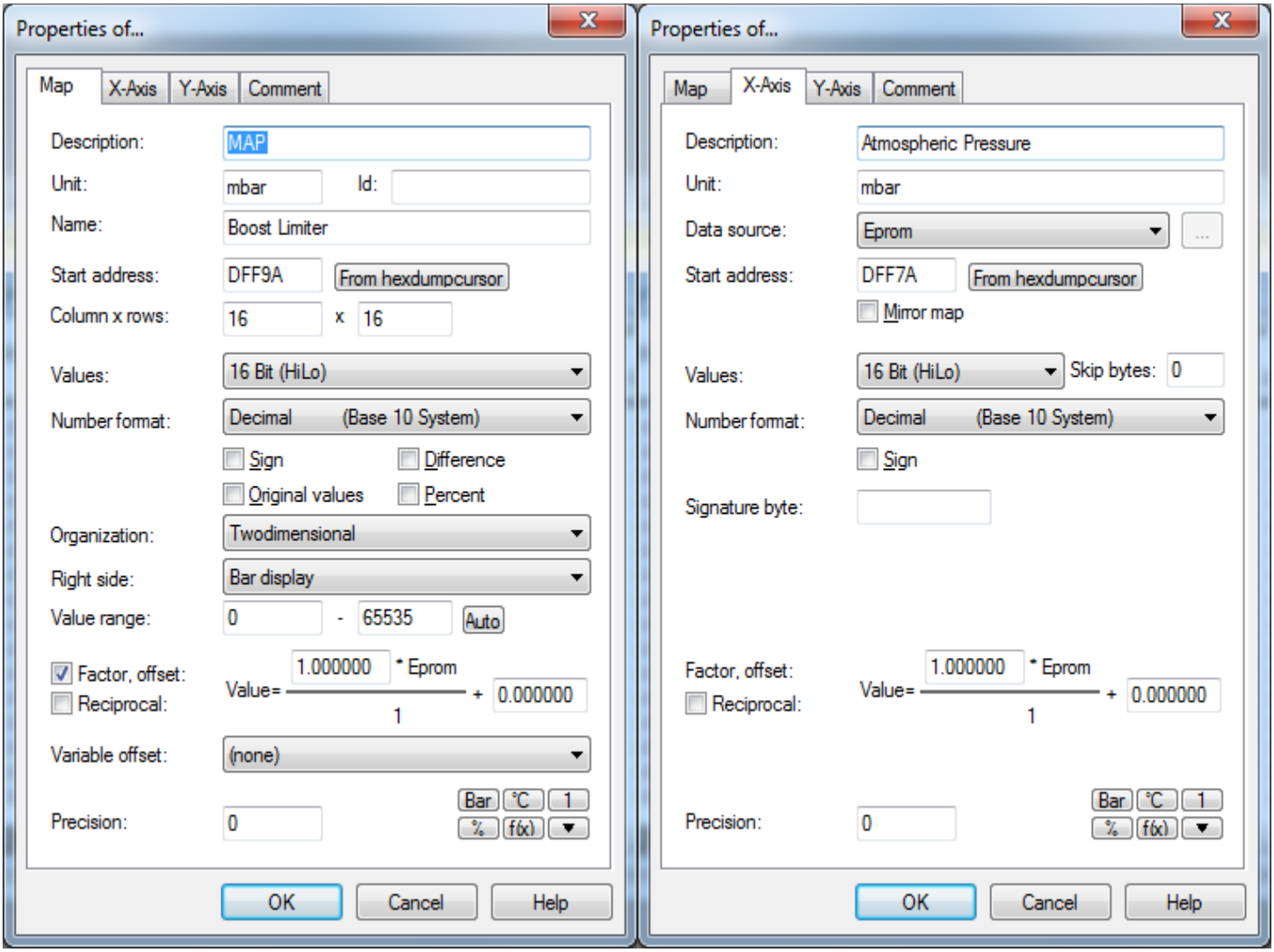


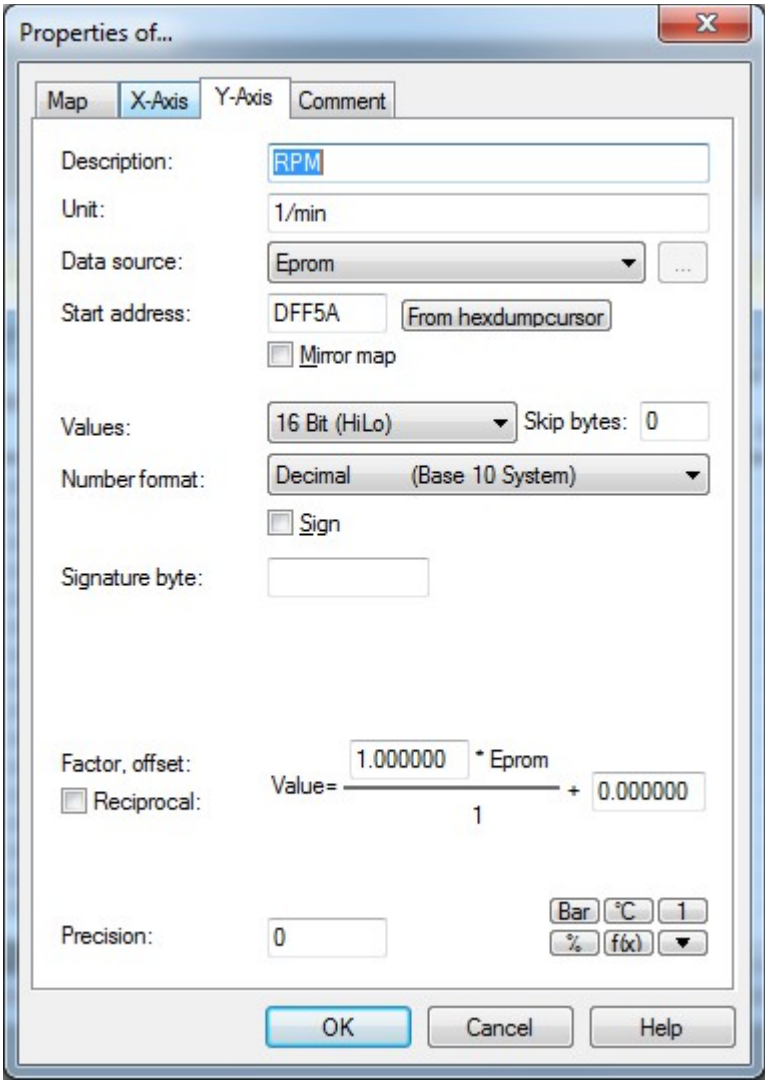

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
DFCD4
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

16. Turbo (Boost) limiter map:

General:

This map limits the required boost depending on the atmospheric pressure and the current rpm.



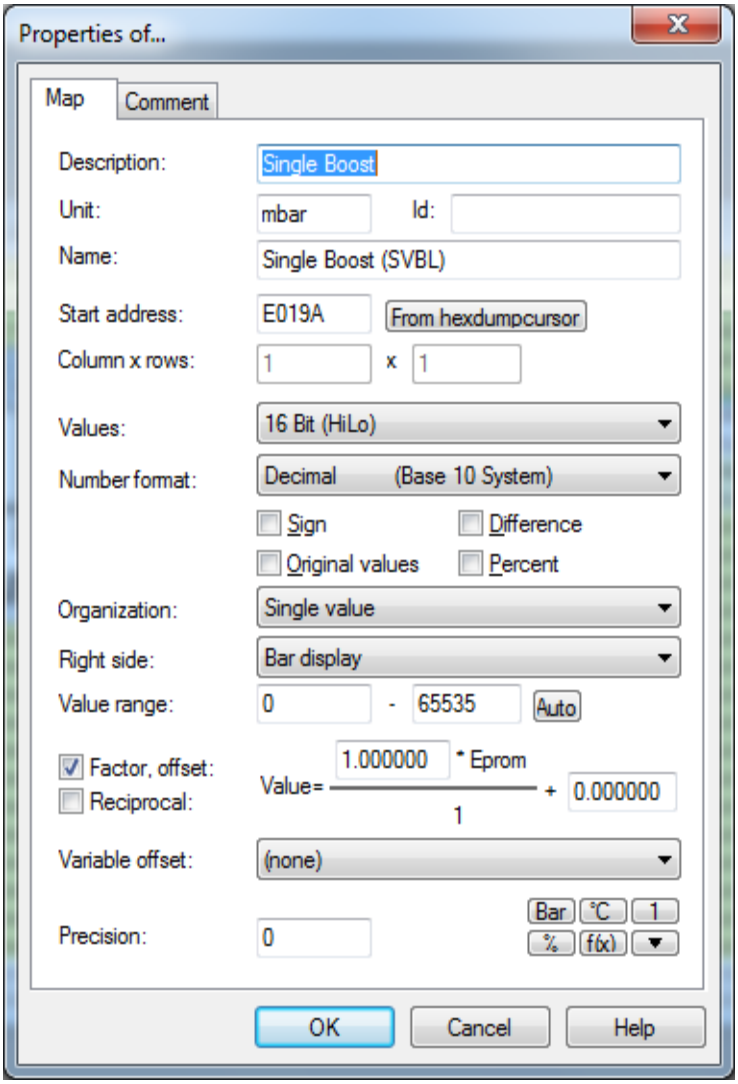

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
DFF5A
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

17. Single value boost limiter:

General:

This value limits the absolute pressure of the turbo. This value can be found by looking directly behind the turbo limiter map. If you look in 2D you see a series of bumps like this:

The SVBL is located at the end of the series of bumps, just before the line "falls" back to "0". In this case it is the highest value between the turbo limitation map and the next map. The value of the SVBL in this file is 2500mBar.



18. **Turbo vanes (N75) map:**

General:

This map controls the vanes inside the turbo at a certain rpm and injected quantity. There is 4 maps, 1st is used during DPF regeneration, 2nd during normal operation.

Requested boost is how much boost the turbo should be making according to the map like in the ECU

Actual boost is how much boost the turbo is making, measured by the MAP (Manifold Absolute Pressure) sensor. this should obviously be similar to the requested value, however it's normal for it to have a little bit of lag, and then spike as the turbo spools up before returning to "about the same as the requested value"

N75 Duty Cycle this is given as a %, the highest it reads to is 75% and the lowest is around 30%. A low duty cycle equates to the ECU asking for more boost from the turbo, and a high duty cycle means the ECU has too much boost already and is requesting the boost be lower. so looking at the graph as accelerator is pressed, more fuel is injected and more boost is requested, as the boost is requested you will see the duty cycle go down, the boost will then rise to the required value as the turbo spools up and then the duty cycle will increase as you go up the revs. It does this because the amount of air flowing through the turbo is increasing, and with that increasing the need for the the vanes to close and build more boost is decreasing, hence the duty cycle rising.

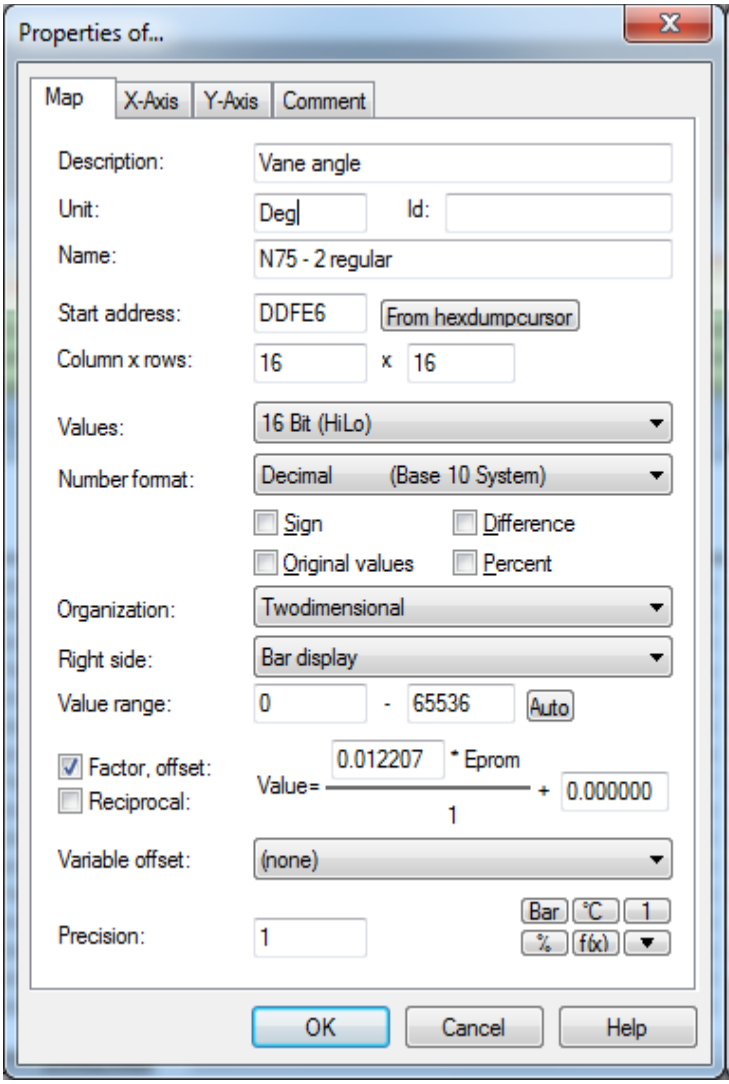
You have the N75 tables, Boost tables and hysteresis tables that work together.

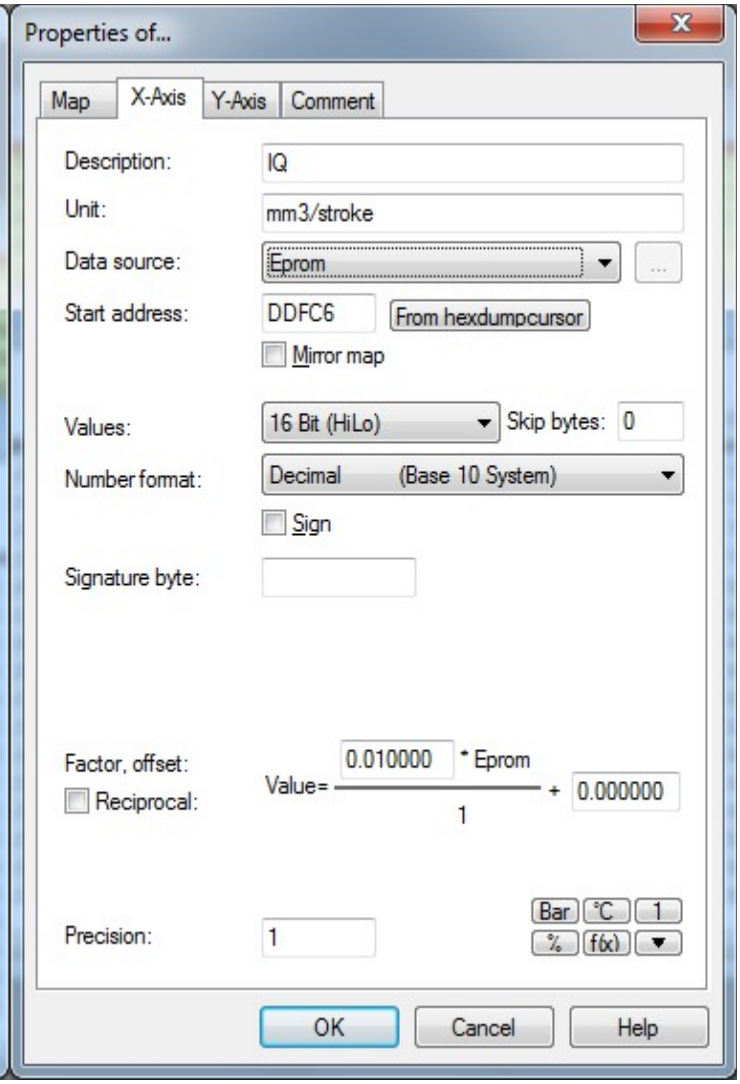
OPENLOOP mode - The turbo is controlled by the N75 wastegate tables only. The ECU does not care how much boost this gives...only that the requested VNT/N75 duty is met.

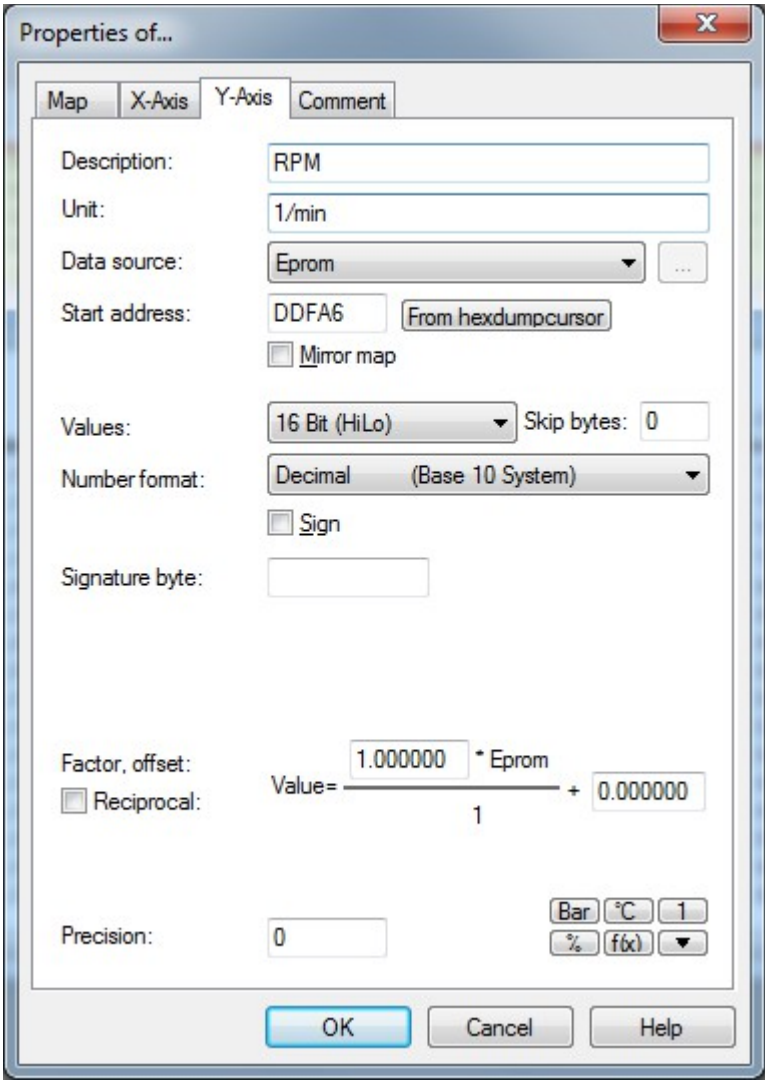
FEEDBACK mode - The turbo is controlled by the PID controller. The ECU looks up requested boost and compares to actual boost. It closes the wastegate to increase actual boost and opens the wastegate to lower actual boost.....whatever is required to get requested boost. The initial wastegate value chosen come from the N75 tables and works from there. So its best to get the N75 values as accurate as possible to begin with.

HYSTERISIS tables - Selecting which mode the turbo should be in is the job of the hysterisis tables. On mine 0-1500rpm @ 40mg + will swap from openloop to feedback. Dropping below 38mg between 0-1500rpm will fall back into openloop mode. Basically at low~ idle speeds the turbo is controlled by the N75 tables only.

You could set hysterisis between 40-38 mg down to 2-1mg instead. This would force Feedback mode at all times. You could set hysterisis to 100-98mg across the whole rpm range. This would force openloop mode at all times.


Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
Vane angle
Unit:
Deg
Id:
Name:
N75 - 2 regular
Start address:
DDFE6
From hexdumpcursor
Column x rows:
16
x
16
Values:
16 Bit (HiLo)
Number format:
Decimal (Base 10 System)
Sign
Difference
Original values
Percent
Organization:
Twodimensional
Right side:
Bar display
Value range:
0
-
65536
Auto
Factor, offset:
Reciprocal:
Value=
0.012207
* Eprom
1
+
0.000000
Variable offset:
(none)
Precision:
1
Bar
°C
1
%
f(x)
OK
Cancel
Help


Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
IQ
Unit:
mm3/stroke
Data source:
Eprom
Start address:
DDFC6
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
Value=
0.010000
* Eprom
1
+
0.000000
Precision:
1
Bar
°C
1
%
f(x)
OK
Cancel
Help

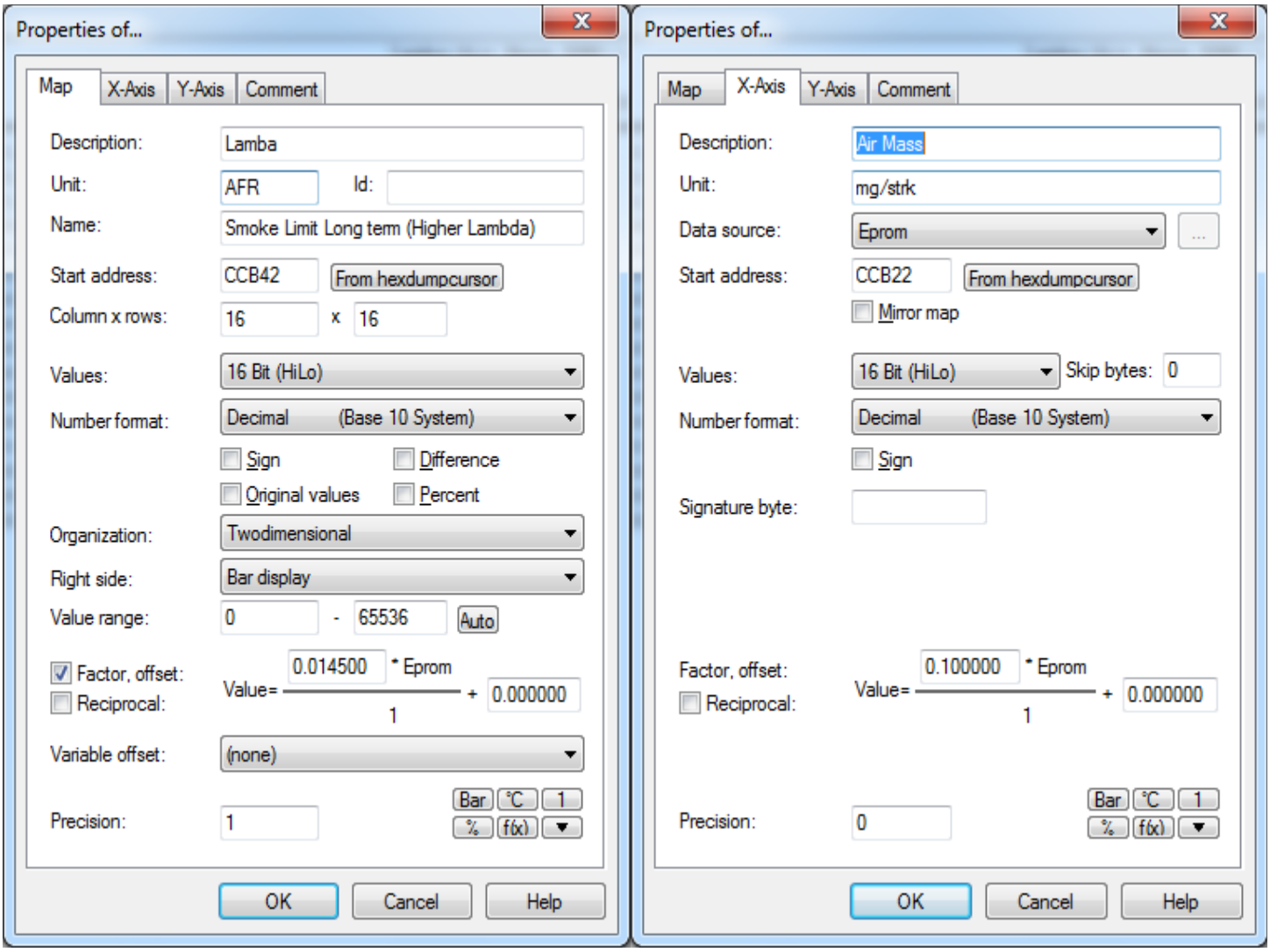

Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
DDFA6
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

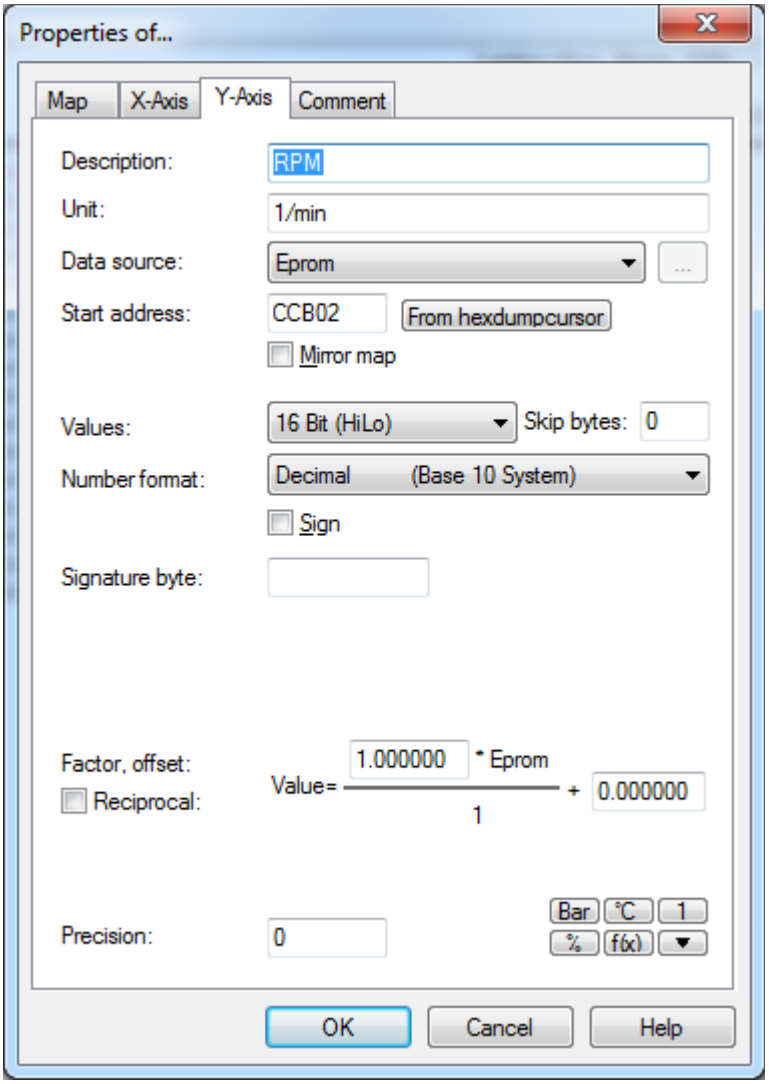
19. Lambda:

General:

Is calculated from the characteristic map FlMng_rLamSmk_MAP in dependence on the supplied to the cylinder air mass AFSCD_mAirPerCylFil and the averaged motor speed Eng_nArvg critical for this operating point lambda FlMng_rLamSmk_mp value determined. The lambda value is the ratio:

$$\text{lambda} = \frac{\text{Air mass present in cylinder}}{\text{Stoechiometric air mass}} = \frac{\text{Air mass present in cylinder}}{\text{Injected fuel mass} * 14.5}$$




Properties of...
Map
X-Axis
Y-Axis
Comment
Description:
RPM
Unit:
1/min
Data source:
Eprom
Start address:
CCB02
From hexdumpcursor
Mirror map
Values:
16 Bit (HiLo)
Skip bytes:
0
Number format:
Decimal (Base 10 System)
Sign
Signature byte:
Factor, offset:
Reciprocal:
1.000000
* Eprom
Value=
1
+
0.000000
Precision:
0
Bar
°C
1
%
f(x)
OK
Cancel
Help

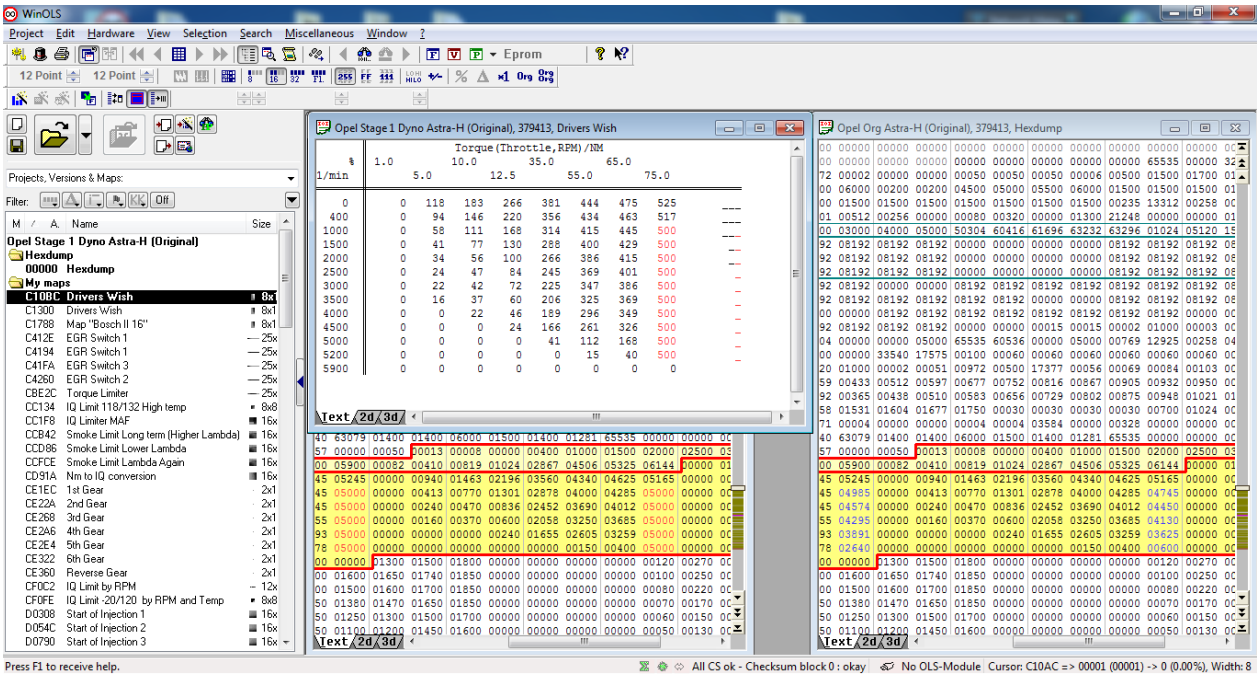
Tuning

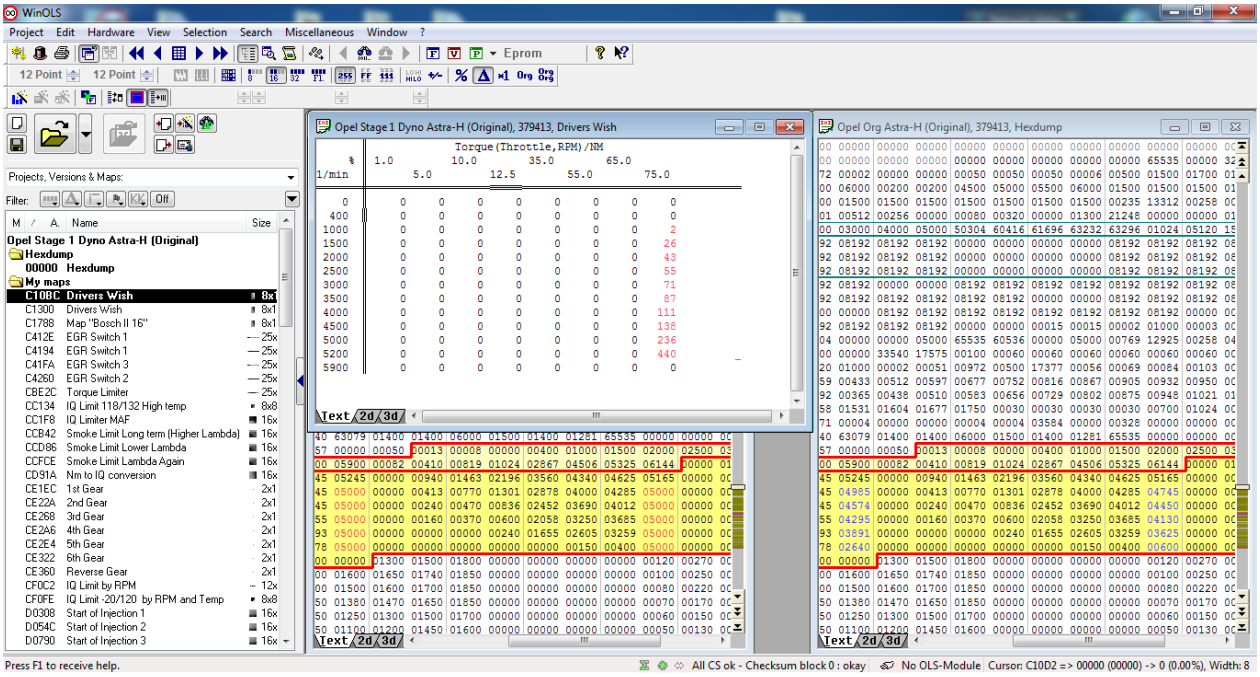
Fuel related maps

This example is from car tuned by popular tuner. While he works all over with increase of 20%, for safety I did my car with only 15% increases (and so in this example).

1. **Drivers wish Maps:**

If we want to tune a stock cdti/jtd engine it is enough to change the driver wish, torque limiter, smoke limiter, IQ limiter by IAT, IQ limiter by RPM, IQ limiter by Oil Temp, duration map (sometimes). EGR map and the turbo maps come later on.
The drivers wish can stay the same for pedal request up to 50% (to keep the MPG). Pro tuned Astra have manual transmission and got tuned only last column. To get more power also before the kick down I tune the last two columns. I increase mine by 15% but not more than 500NM, as the NM to IQ map is calibrated to this value. Pro tuner rise all to 500Nm.

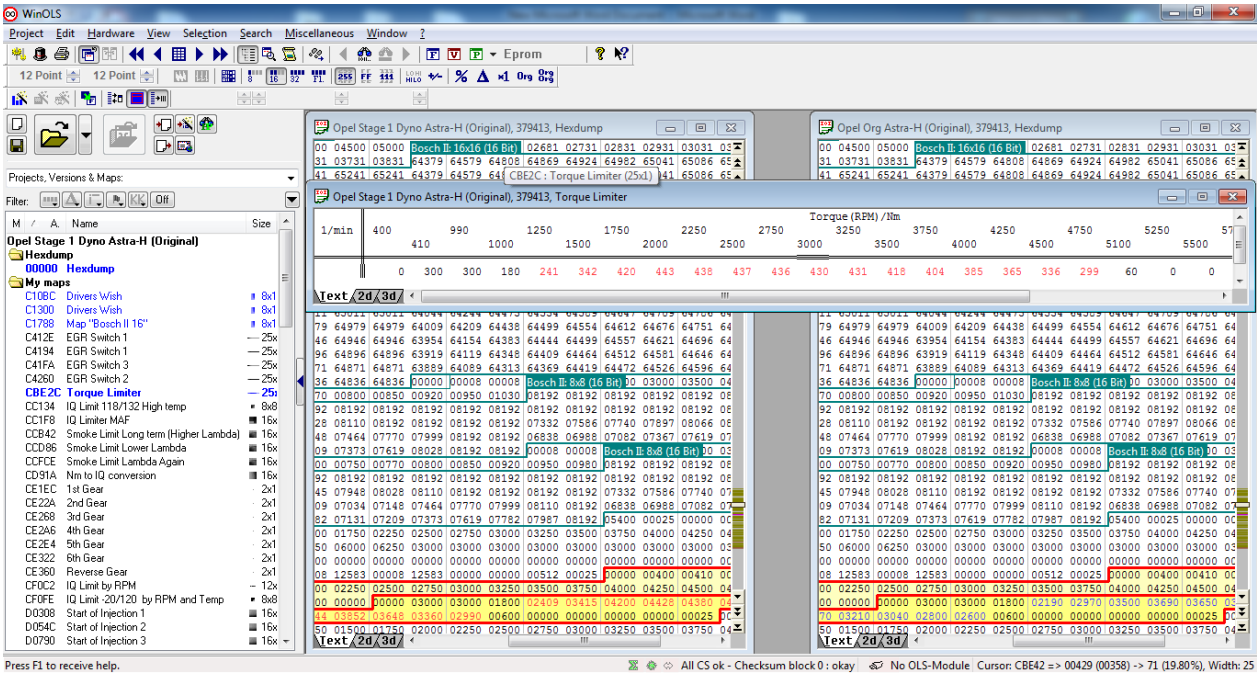



WinOLS
Project Edit Hardware View Selection Search Miscellaneous Window ?
Eprom
12 Point 12 Point
Projects, Versions & Maps:
Filter: Off
M / A. Name Size
Opel Stage 1 Dyno Astra-H (Original)
Hexdump
00000 Hexdump
My maps
C10BC Drivers Wish 8x
C1300 Drivers Wish 8x1
C1788 Map "Bosch II 16" 8x1
C412E EGR Switch 1 25x
C4194 EGR Switch 1 25x
C41FA EGR Switch 3 25x
C4260 EGR Switch 2 25x
CBE2C Torque Limiter 25x
CC134 IQ Limit 118/132 High temp 8x8
CC1F8 IQ Limiter MAF 16x
CCB42 Smoke Limit Long term (Higher Lambda) 16x
CCD86 Smoke Limit Lower Lambda 16x
CCFCE Smoke Limit Lambda Again 16x
CD91A Nm to IQ conversion 16x
CE1EC 1st Gear 2x1
CE22A 2nd Gear 2x1
CE268 3rd Gear 2x1
CE2A6 4th Gear 2x1
CE2E4 5th Gear 2x1
CE322 6th Gear 2x1
CE360 Reverse Gear 2x1
CF0C2 IQ Limit by RPM 12x
CF0FE IQ Limit -20/120 by RPM and Temp 8x8
D0308 Start of Injection 1 16x
D054C Start of Injection 2 16x
D0790 Start of Injection 3 16x
Opel Stage 1 Dyno Astra-H (Original), 379413, Drivers Wish
Torque (Throttle, RPM) /NM
% 1.0 10.0 35.0 65.0
1/min 5.0 12.5 55.0 75.0
Text 2d 3d
Opel Org Astra-H (Original), 379413, Hexdump
Text 2d 3d
Press F1 to receive help.
All CS ok - Checksum block 0 : okay
No OLS-Module Cursor: C10D2 => 00000 (00000) -> 0 (0.00%), Width: 8

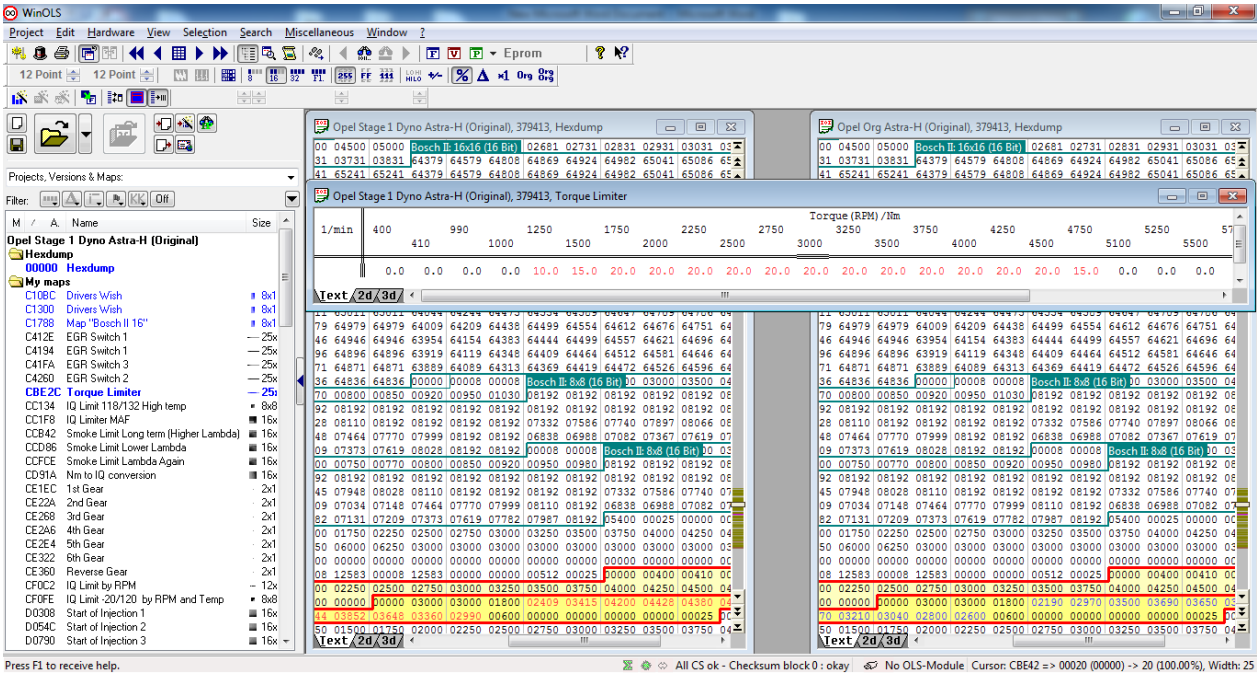
2. Torque limiter:

The torque limiter can be increased up to 4500rpm by ± 15%, leave car stock over those rpm (hard cut). Do not reduce the requested % in before 4500rpm as it will make your car powerful at low and powerless at high rpm (very inconvenient for overtaking, especially on auto-gearbox kick-down).
To avoid clutch problem start from 1250 with less %, and has the max % at 2000rpm on. So you will keep similar torque curve shape.

To give an example looks at the picture below. It is an original text view of the torque limiter.

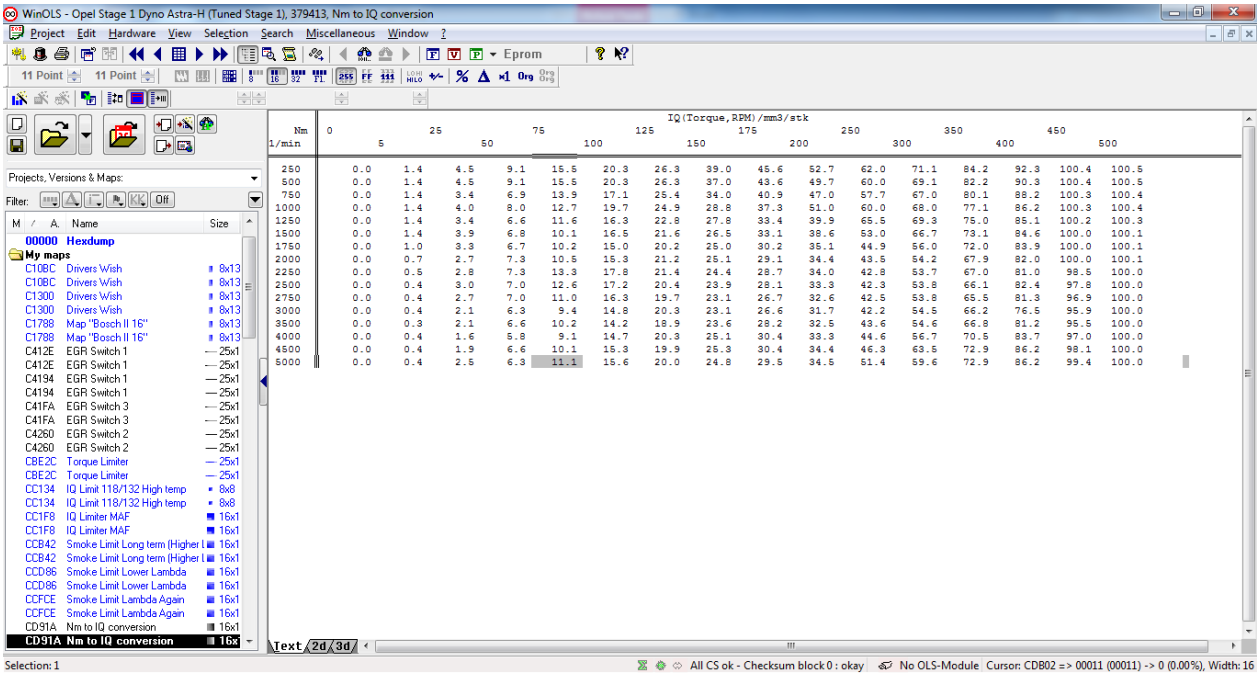


The modified torque limiter in % can look something like the picture below.



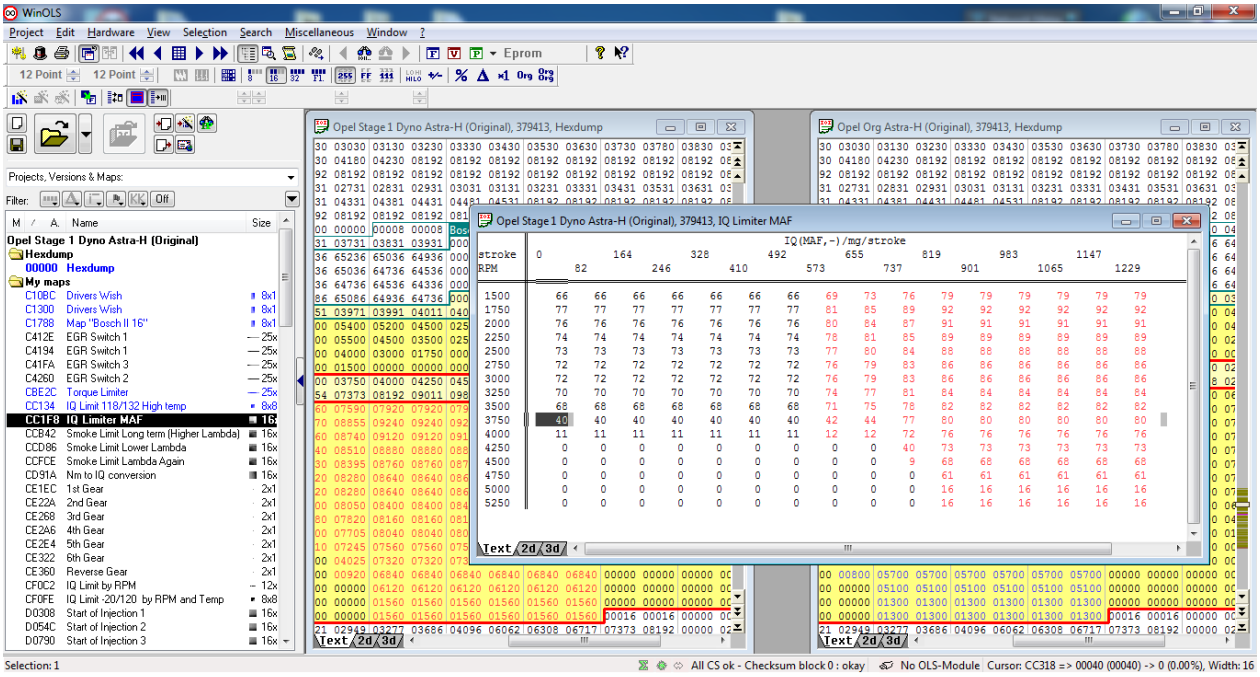
3. Nm to IQ conversion map:

This map usually stays stock for CRS. However when some of the SV limiters are missed to avoid being embarrassed paid tuners yield to temptation of de-calibrating the engine. Should be used with caution when tuning auto-gearbox cars. Many VAG owners got bad experience. As mention above Vectra got calibration to up to 500NM, so should be enough for stock tuning.

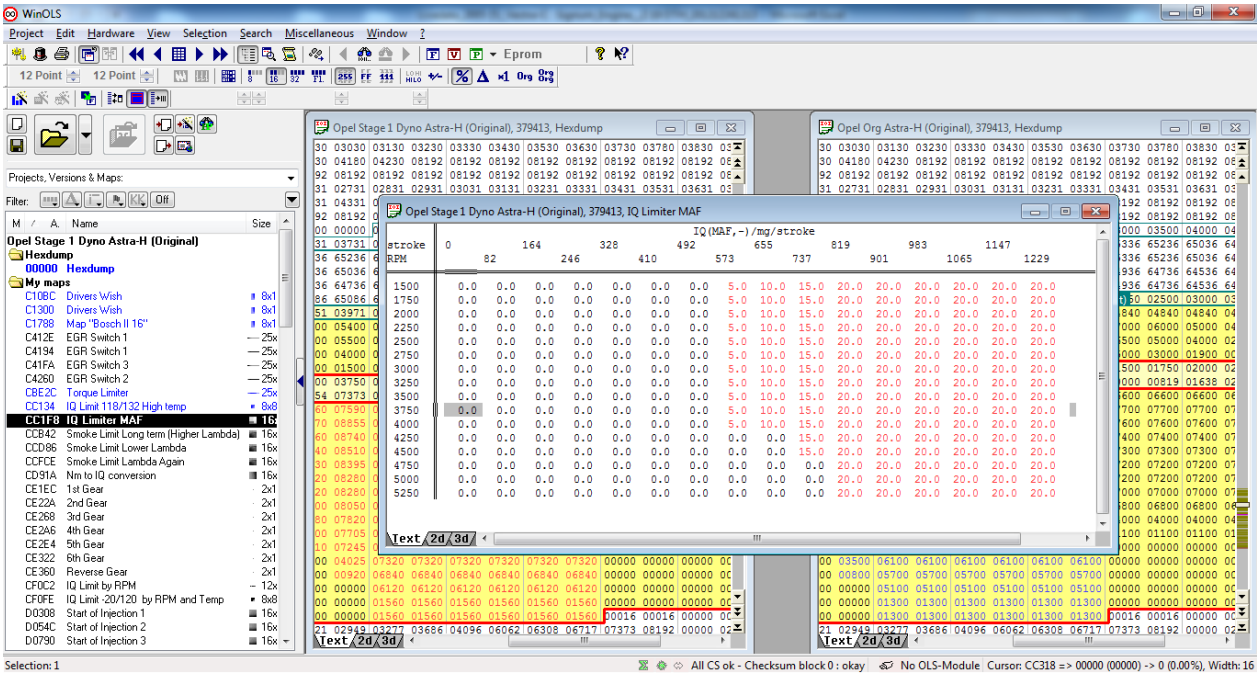


4. IQ limiter map:

This is map for engine speed dependent quantity limitation and the X-Axes is “minimum prevention factor calculated from temperature curves”. I wrong to point it as Smoke map. So handle it as IQ limiter , add same increase in %. Let says you can start from half of the map area increasing by 5%, then 7.5%, 10%, 12.5% and make the whole last quarter +15% or 20%.

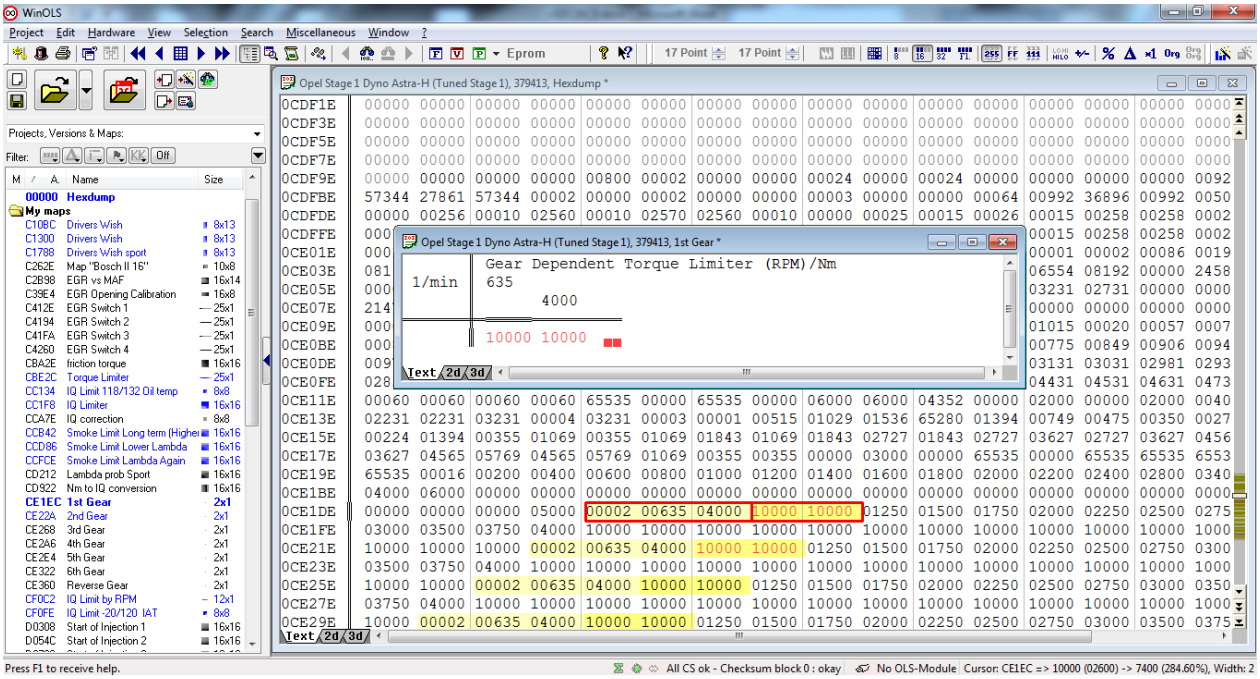


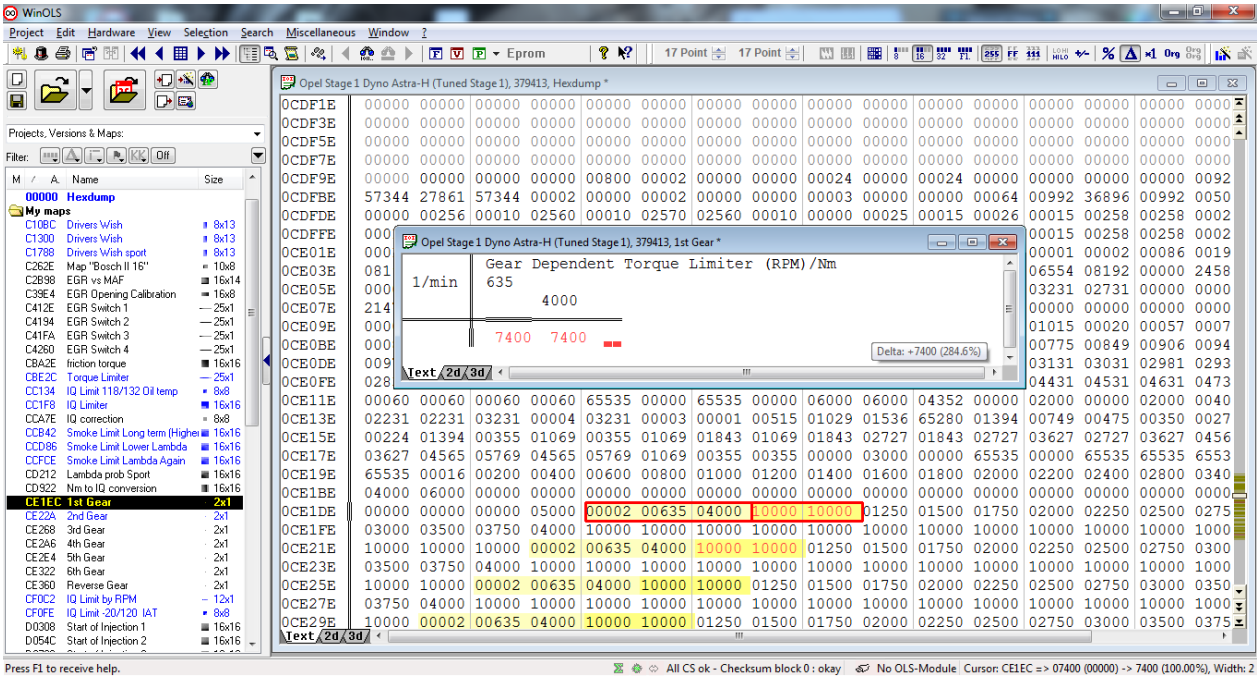
Original the text view of the smoke map looked like the picture



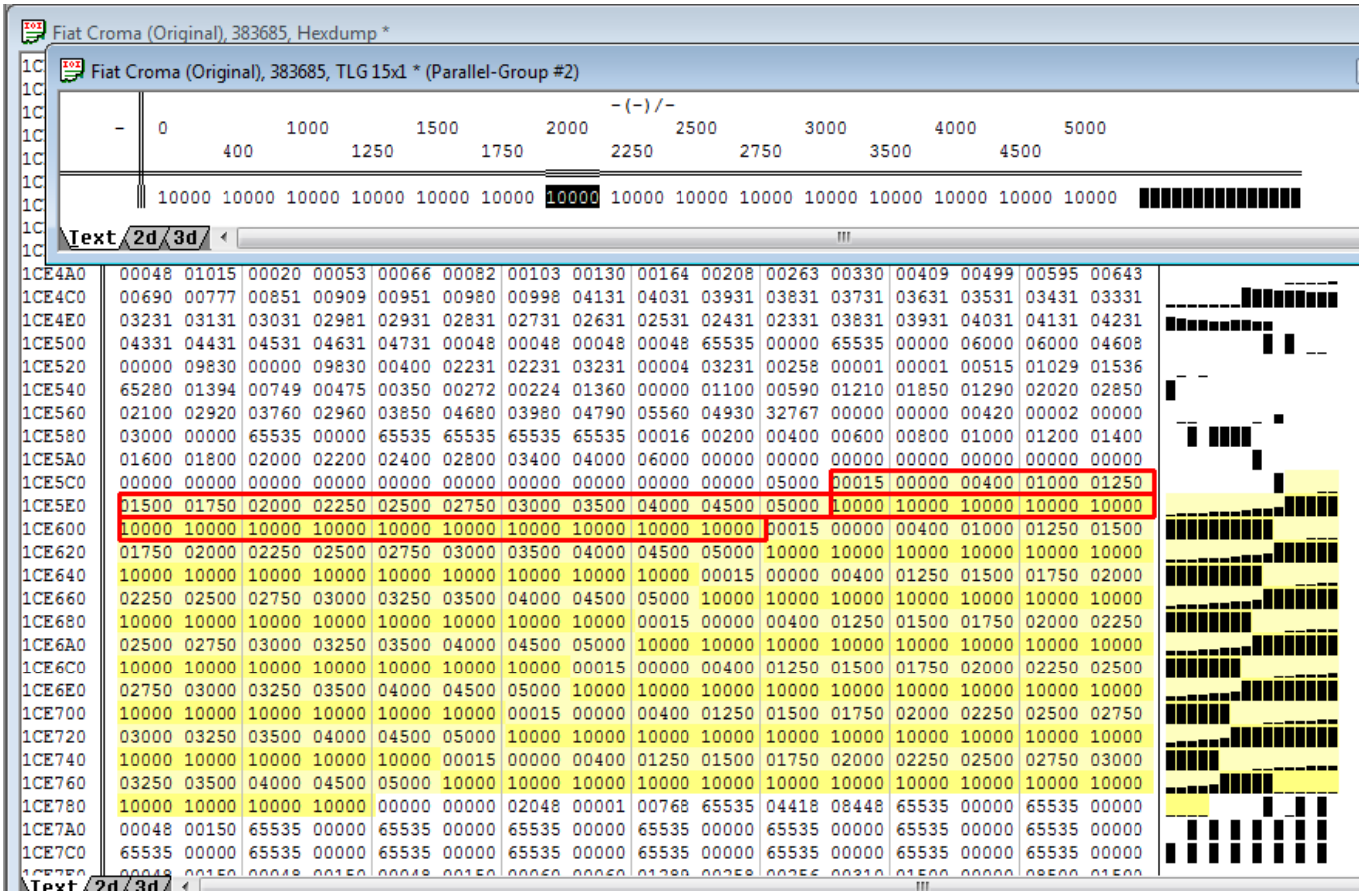
5. Gear Dependent Torque Limiter

For cars with manual transition first and second gears are limited to 260Nm. For automatic transition 1st and 2nd gear has the same limits as 3rd, 4th, 5th, and 6th gear of the manual. So on cars with automatic transition there is no need to touch those maps, limit is already 1000Nm. Aisin Warner AF40-6 is rated well above 260Nm.
However be advised that 2nd gear is the one (in AF40 namely - clutch 1 or band 1) that fail in most auto gear boxes.



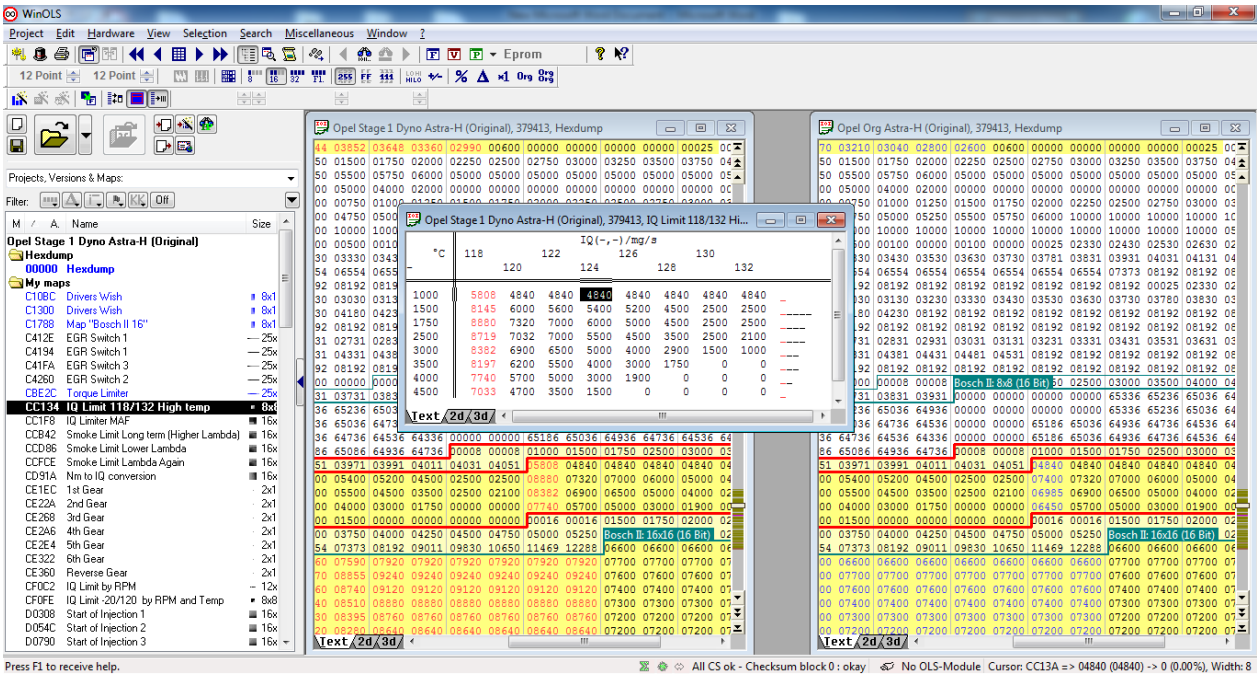


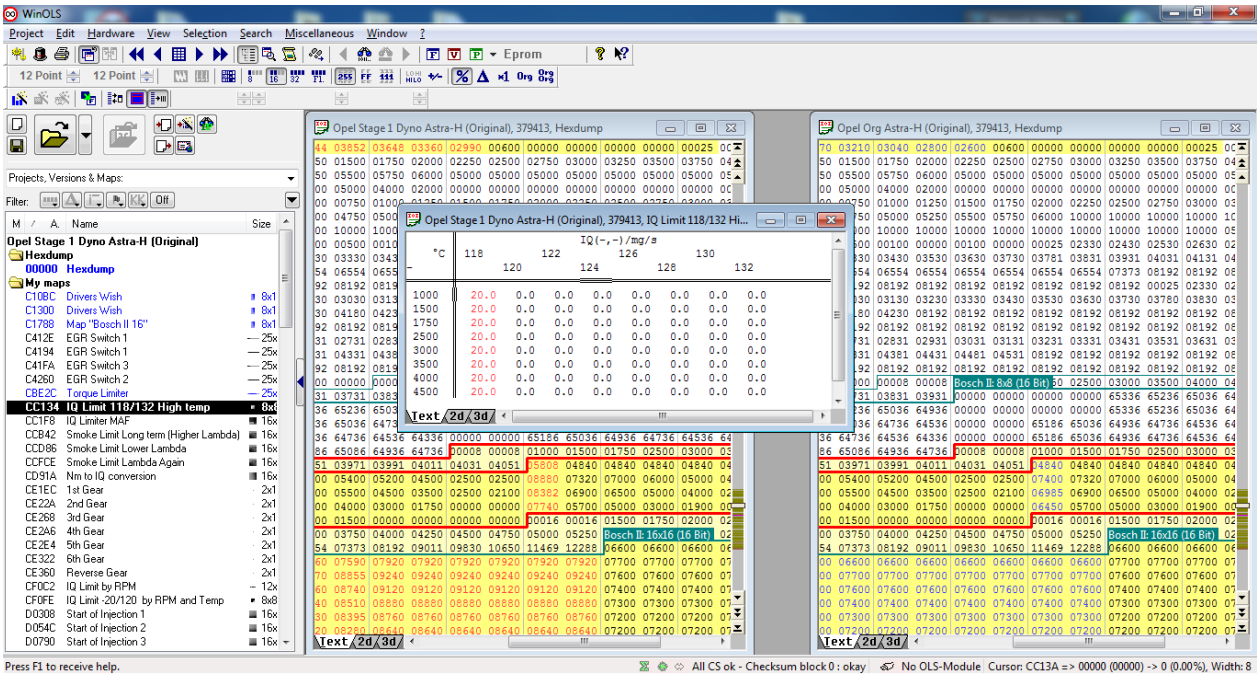
Fiat Chroma Gear Dependent Torque Limiter. Here you can see normal map start with dimensions 00015|00000|*****



6. IQ limit by Coolant Temperature

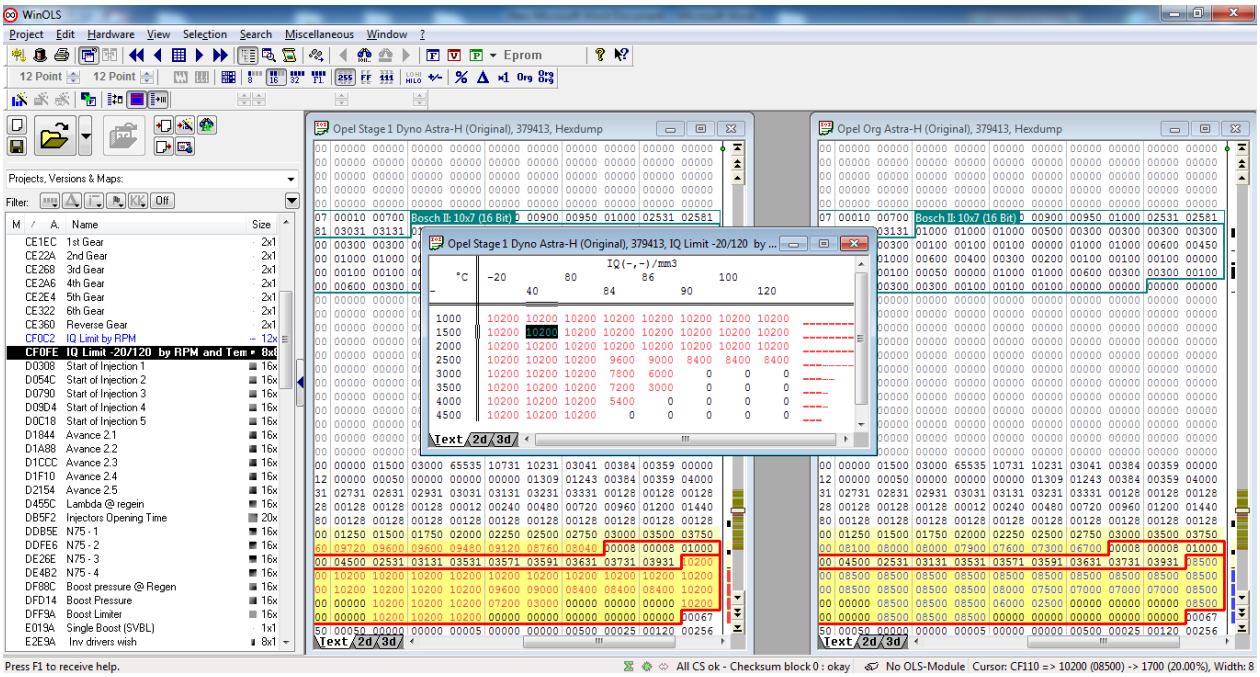
I this map limit IQ based on the Engine Coolant Temp. I just follow pro tuners work and increasing the values by 15%, leaving last columns stock for safety margin.

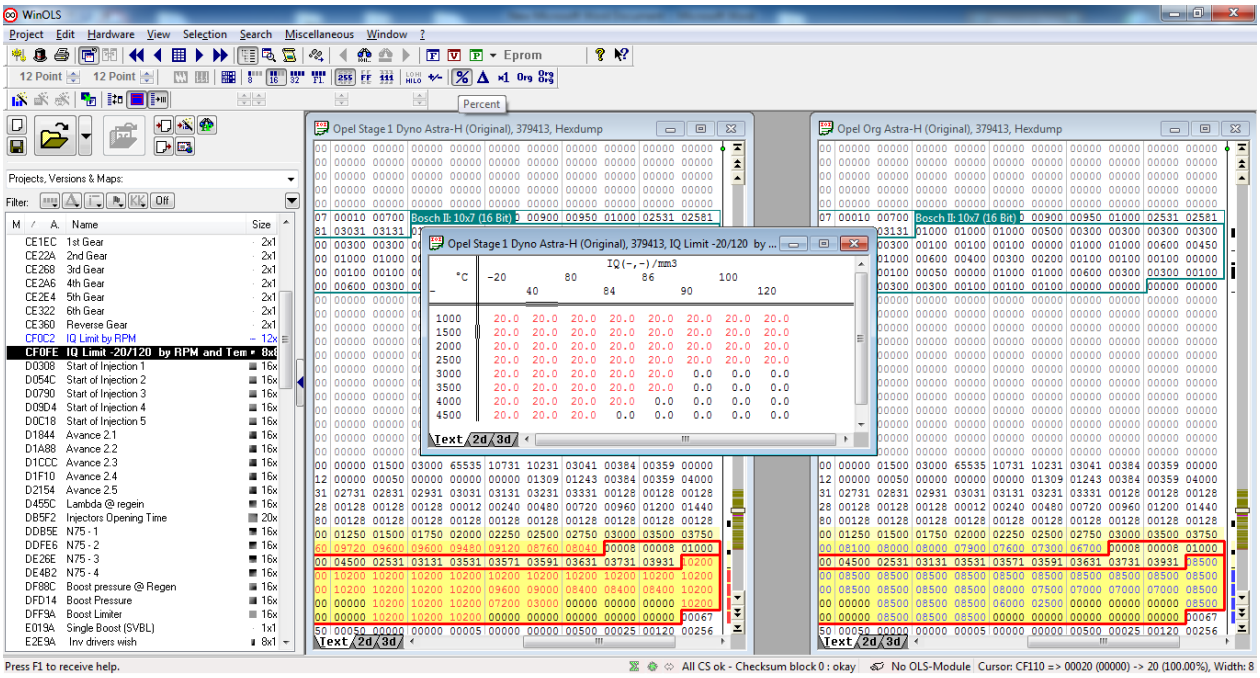




7. IQ limit by Fuel Temperature

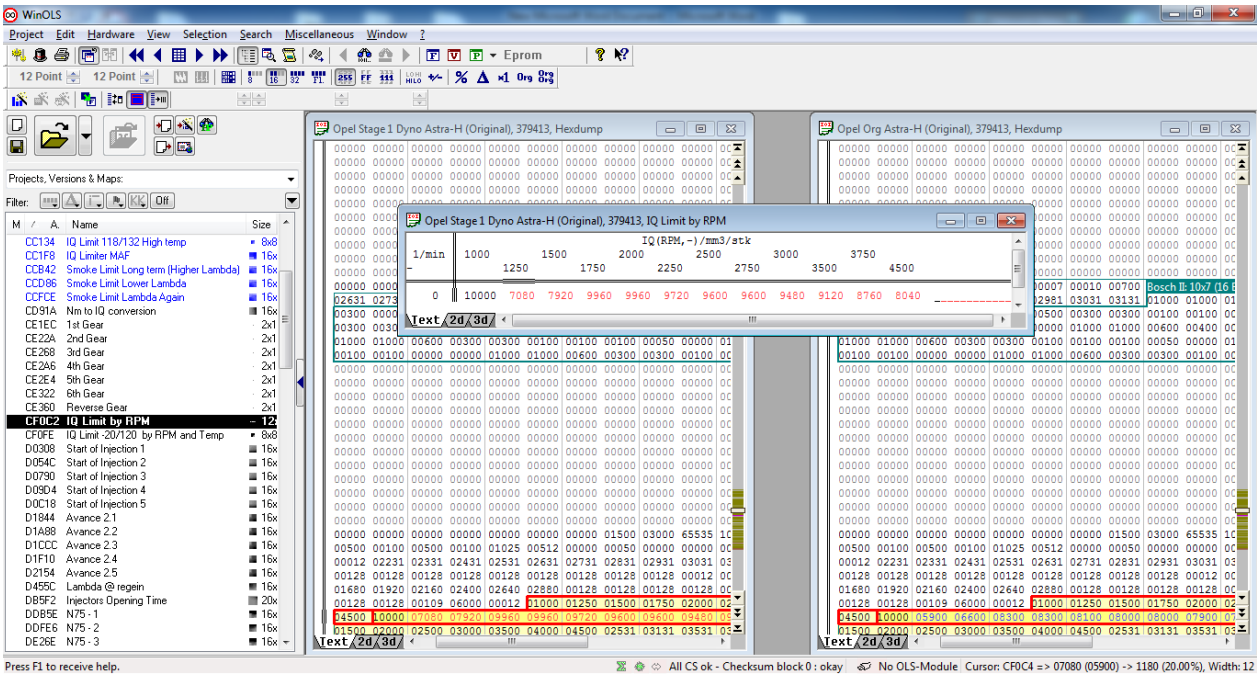
I this map limit IQ based on the Fuel Temperature. I follow pro tuners work and increasing the values by 15%, leaving last three columns stock for safety margin. In my logs fuel T is always less than 40C (about 5C – 37C).

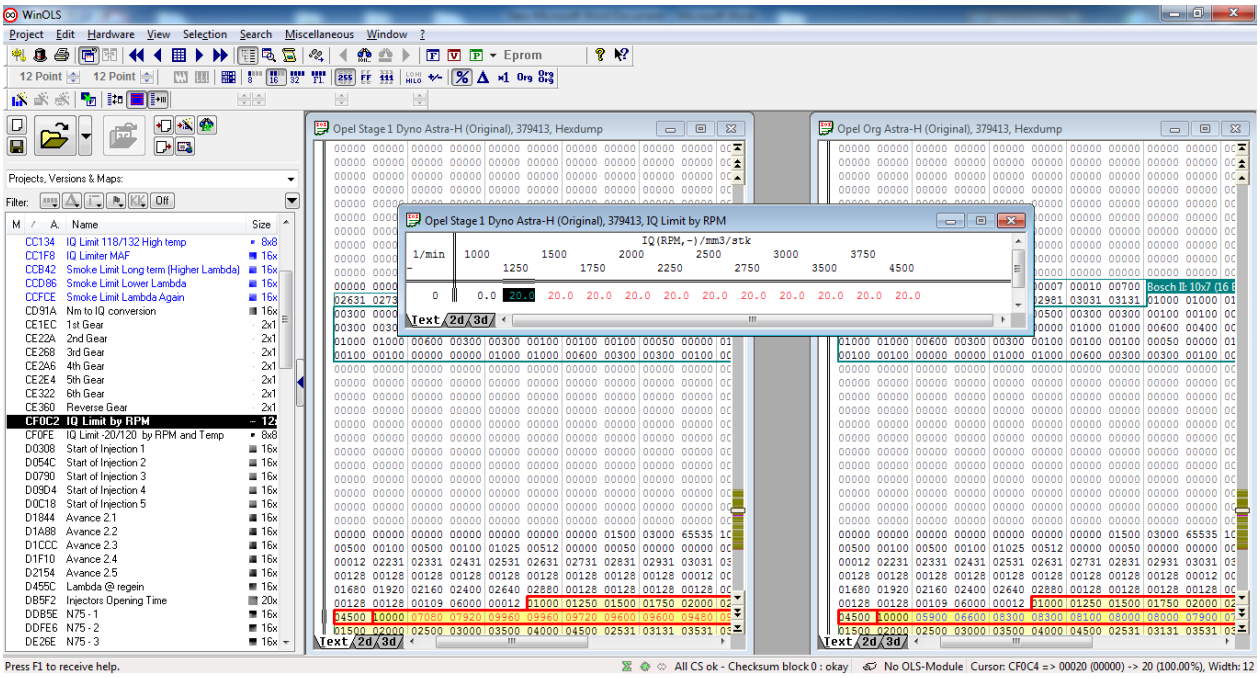




8. IQ limit by RPM

I this map limit IQ based on the engine RPM. I follow pro tuners work and increasing the values by 15%, leaving last columns stock for safety margin.

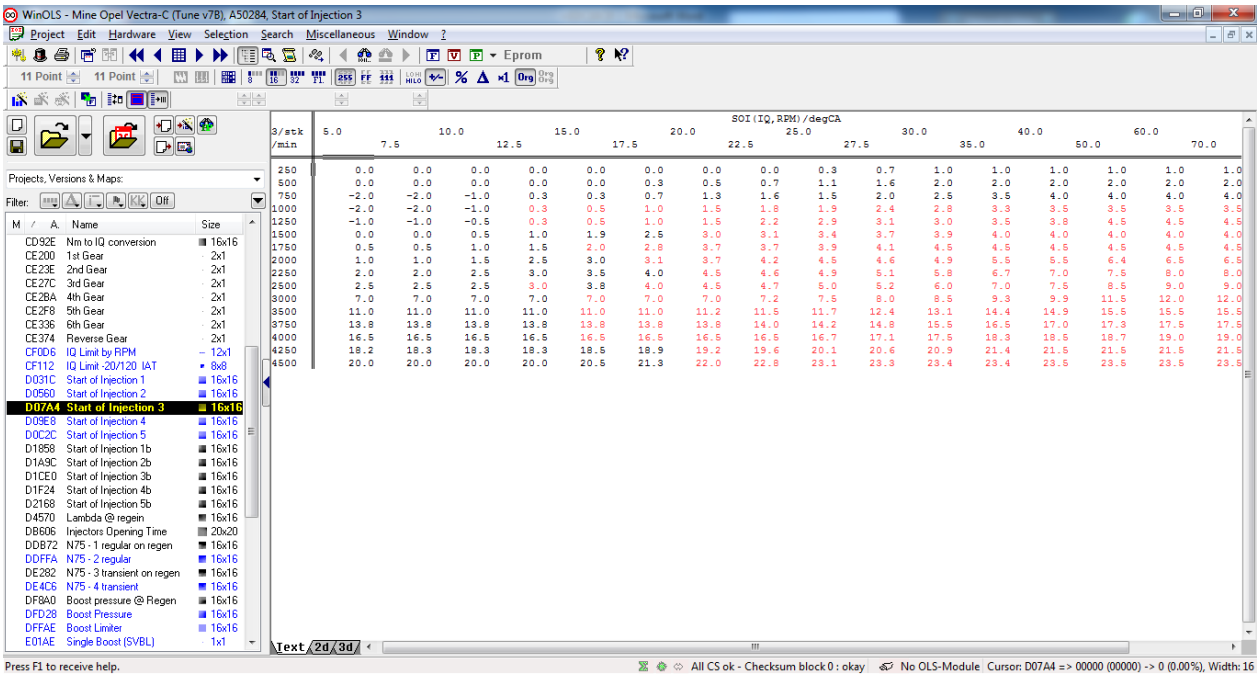




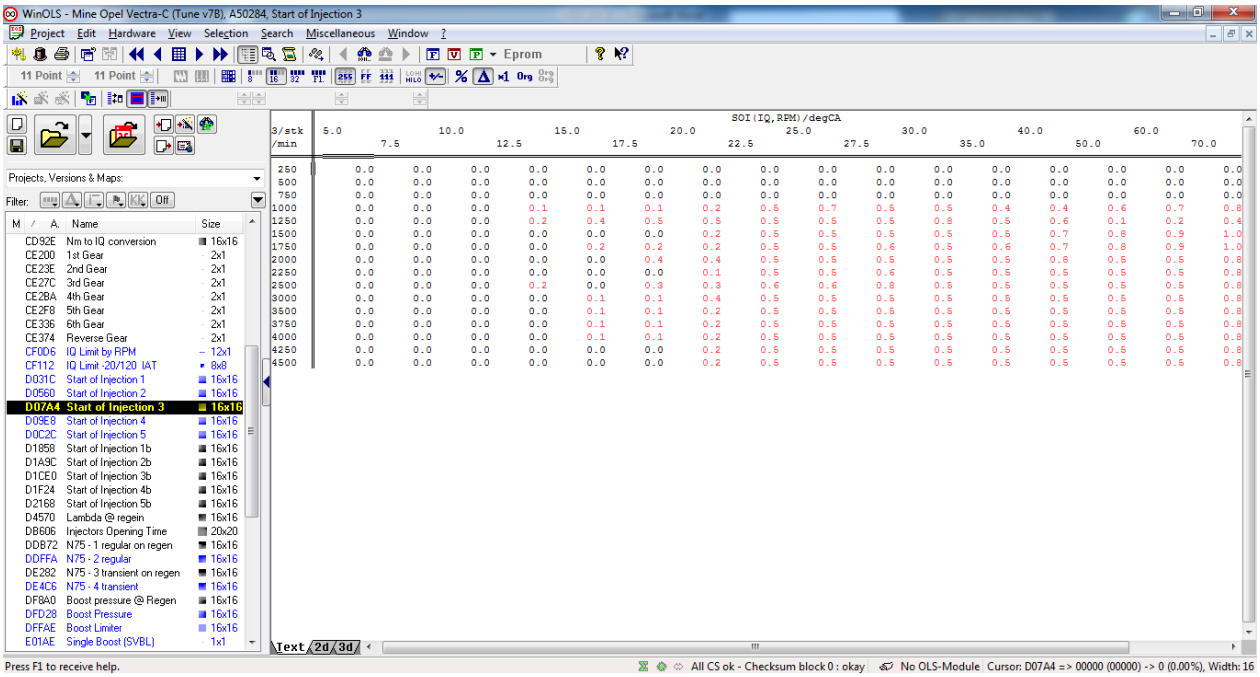
9. Start Of Injection map:

Pro tuner **left this map stock (better do the same)**. I advanced mine all over the IQ and revolution range by 2.0deg on steps by 0.5 deg at a time. “Luckily” I did blow out the O-ring of one of my injectors. So I go back to + 0.2/+1.0 deg rounding the 3D graph. Highest increase fills up the holes @1500rpm out of EGR working area.
You should bear in mind that switching off EGR increase speed of combustion, increasing boost advance start of combustion, and increasing rail pressure will make injecting higher quantity BTDC. So finally better stay on safe side and do not play to much with SOI. Comparing mine SOI to Astra w/o DPF I found out, my car running retarded with delta (-1 to -2) in low IQ and RPMs. Astra got also higher boost and rail pressure, but less EGR at this range.

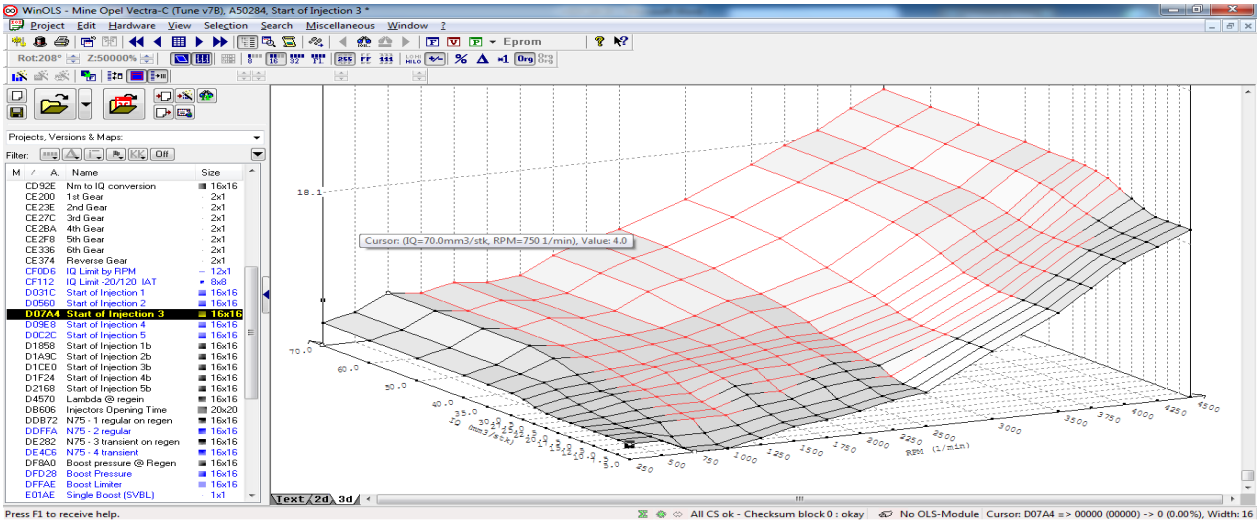
ORIGINAL SOI



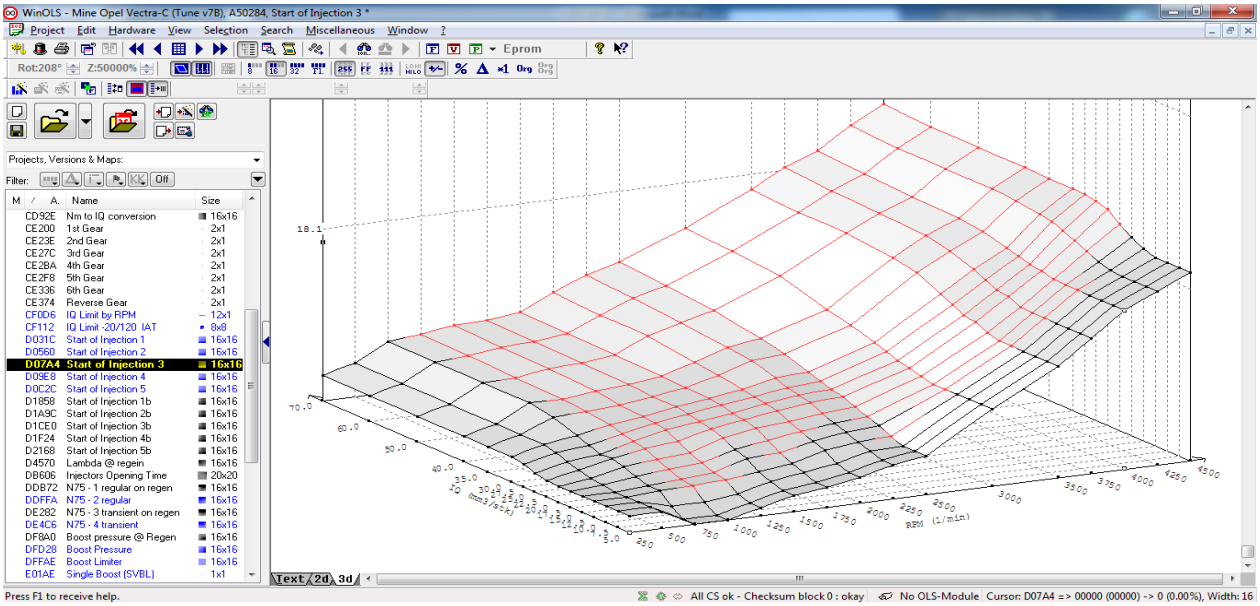
TUNED



ORIGINAL IN 3D



UNED IN 3D



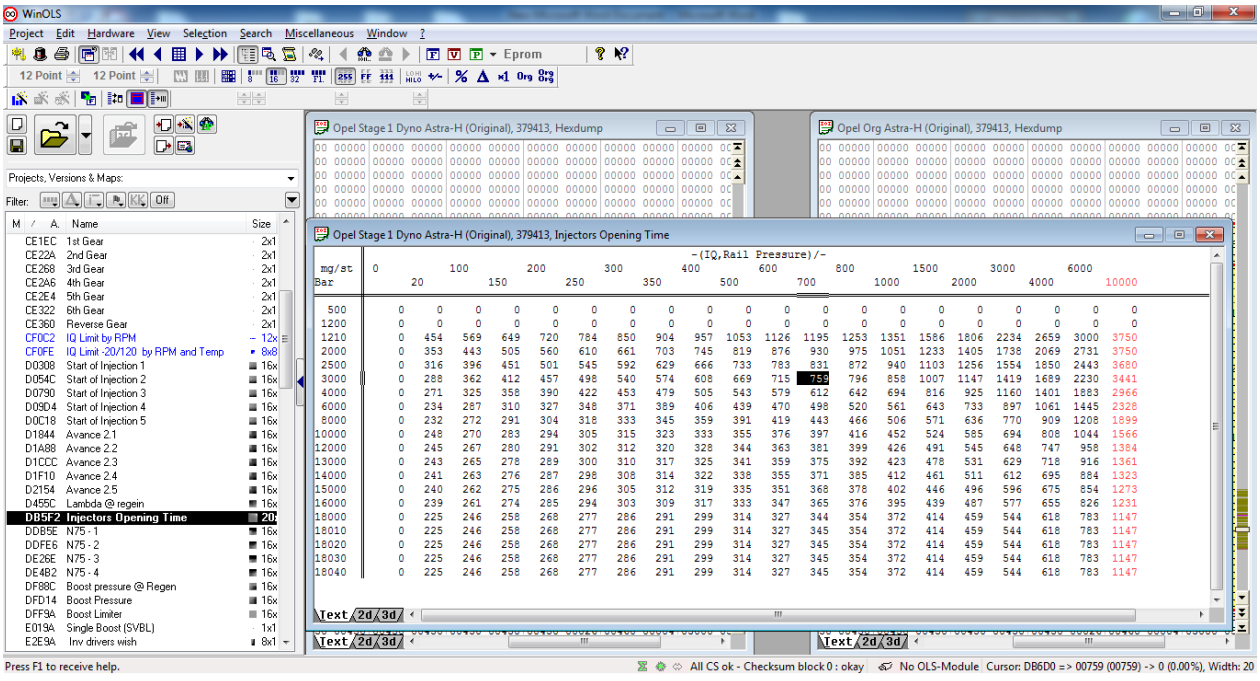
Final version of my SOI3 (“delta”-difference from org) coping low IQ and RPM range from Astra w/o DPF.

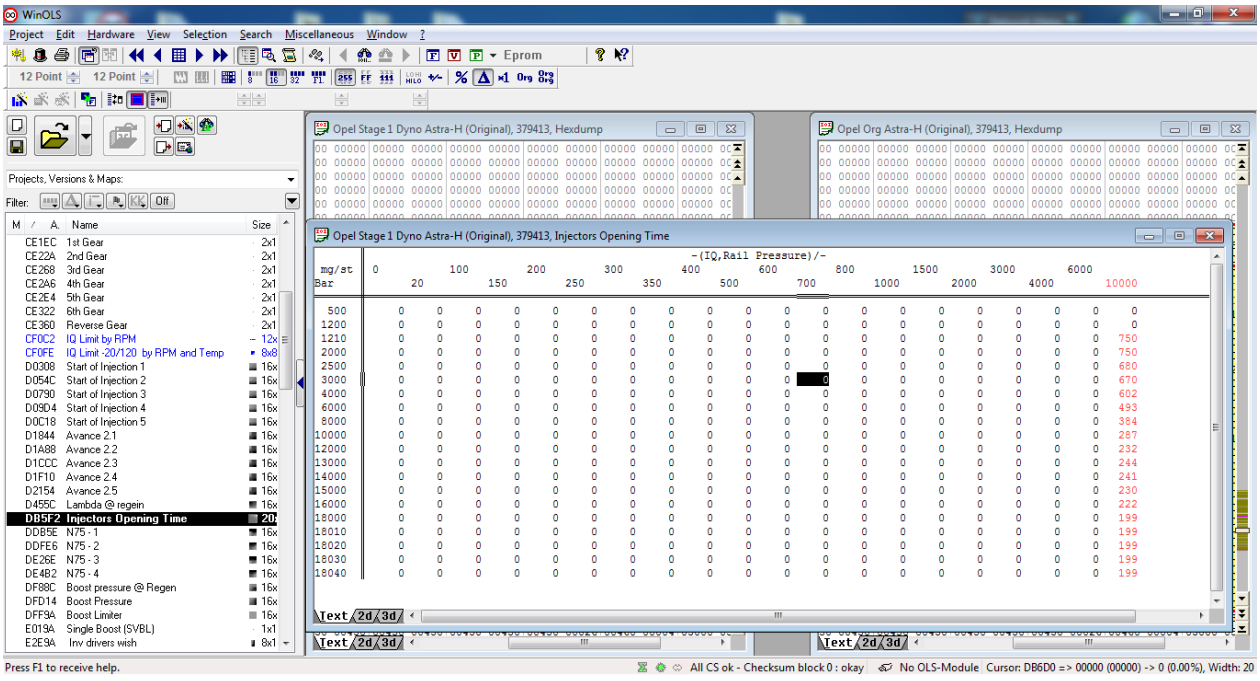
	SOI(IQ,RPM)/degCA															
m3/stk	5.0		10.0		15.0		20.0		25.0		30.0		40.0		60.0	
1/min		7.5		12.5		17.5		22.5		27.5		35.0		50.0		70.0
250	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
750	1.3	1.5	0.6	0.0	0.4	0.2	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000	1.5	1.7	1.0	0.2	0.5	0.5	0.4	0.5	0.7	0.5	0.5	0.4	0.4	0.6	0.7	0.8
1250	0.8	1.3	1.2	0.8	1.0	1.1	0.8	0.5	0.5	0.5	0.8	0.5	0.6	0.1	0.2	0.4
1500	0.3	0.8	0.7	0.7	0.2	0.1	0.2	0.5	0.5	0.5	0.5	0.5	0.7	0.8	0.9	1.0
1750	0.3	1.0	0.7	0.6	0.6	0.3	0.2	0.5	0.5	0.6	0.5	0.6	0.7	0.8	0.9	1.0
2000	0.4	1.1	0.9	0.2	0.1	0.5	0.4	0.5	0.5	0.6	0.6	0.5	0.8	0.5	0.5	0.8
2250	0.1	0.6	0.6	0.4	0.4	0.1	0.1	0.5	0.5	0.7	0.5	0.5	0.5	0.5	0.5	0.8
2500	0.3	1.0	1.2	1.2	0.5	0.6	0.6	0.8	1.1	1.2	0.9	0.5	0.5	0.5	0.5	0.8
3000	0.0	0.0	0.0	0.0	0.1	0.1	0.4	0.5	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.8
3500	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8
3750	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8
4000	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8
4250	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8
4500	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8

10. Injector opening time (Duration map):

The duration maps may need to be changed also. Otherwise the duration map will limit the injected quantity at the highest possible axis. So we need to change the axis value from 80mg/stroke to 100mg/stroke in this case. And extrapolate injector opening time for the new IQ axis. You can see in the example how pro tuner did it. However you can choose different values as it the opening time not rising in progression.

It is visible that when stock injector opening time is never more than 3000 micro sec, and got same values for lowest rail pressure and IQ 60 - 80mg/stroke(for all 1.9DTH engines including Opel, Fiat and SAAB). So maybe it is not advisable to go over those timing, even so I don't think the car will ever operate at that CRS pressure/IQ/RPM range.





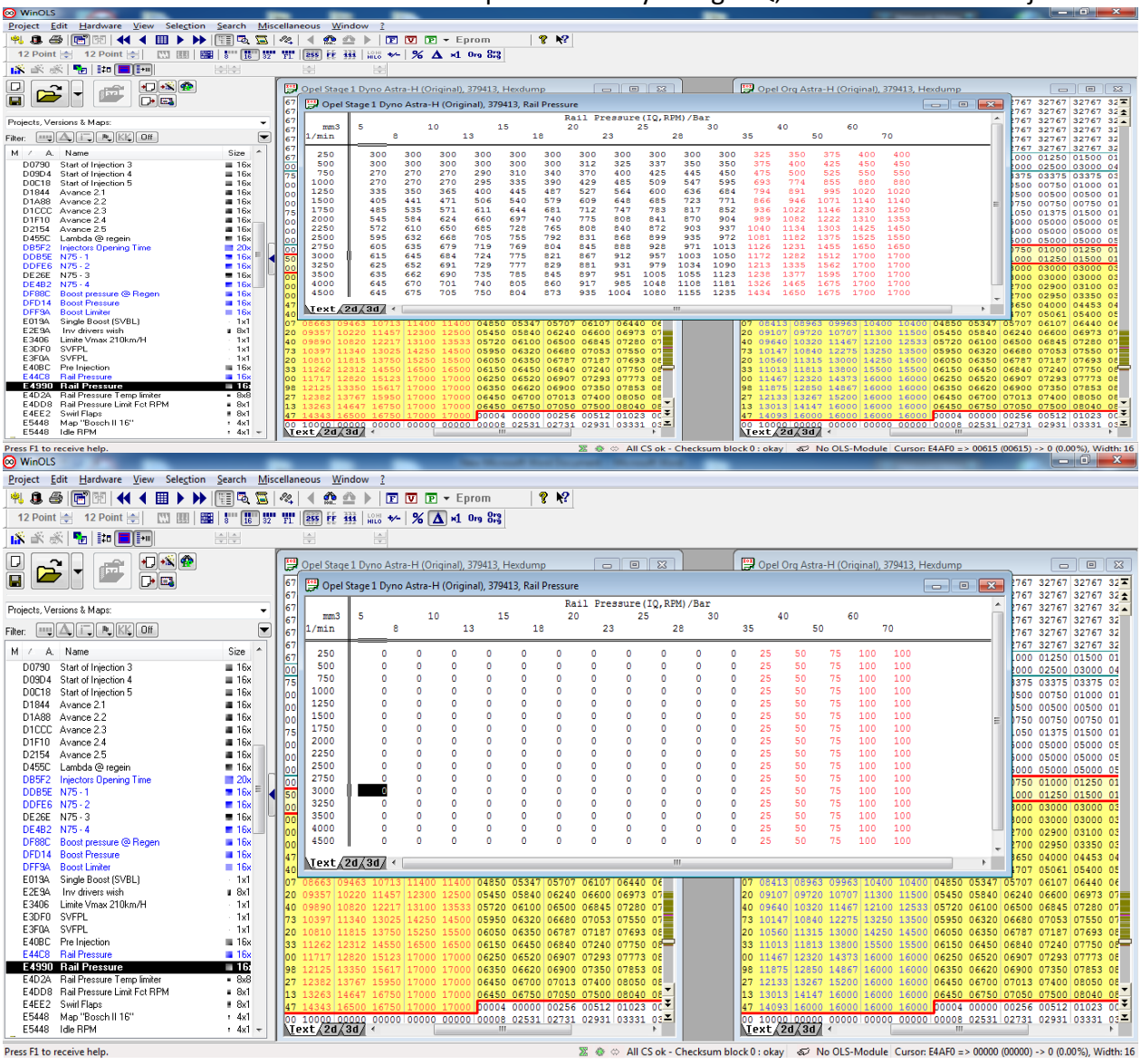
11. CRS Rail Pressure:

A positive effect of increased fuel pressure... is that forcing the fuel through the same injector at a higher pressure tends to improve fuel atomization. This will tend to improve fuel distribution and combustion efficiency, and may contribute to improved fuel economy. The benefits of higher pressure are accompanied by some additional concerns, the main one being safety. With fuel lines and connections being subjected to higher pressure, there naturally is an increased risk of leaks or outright failure. To ensure reliability, the standard Bosch parts are rated for pressures well above the normal operating range...

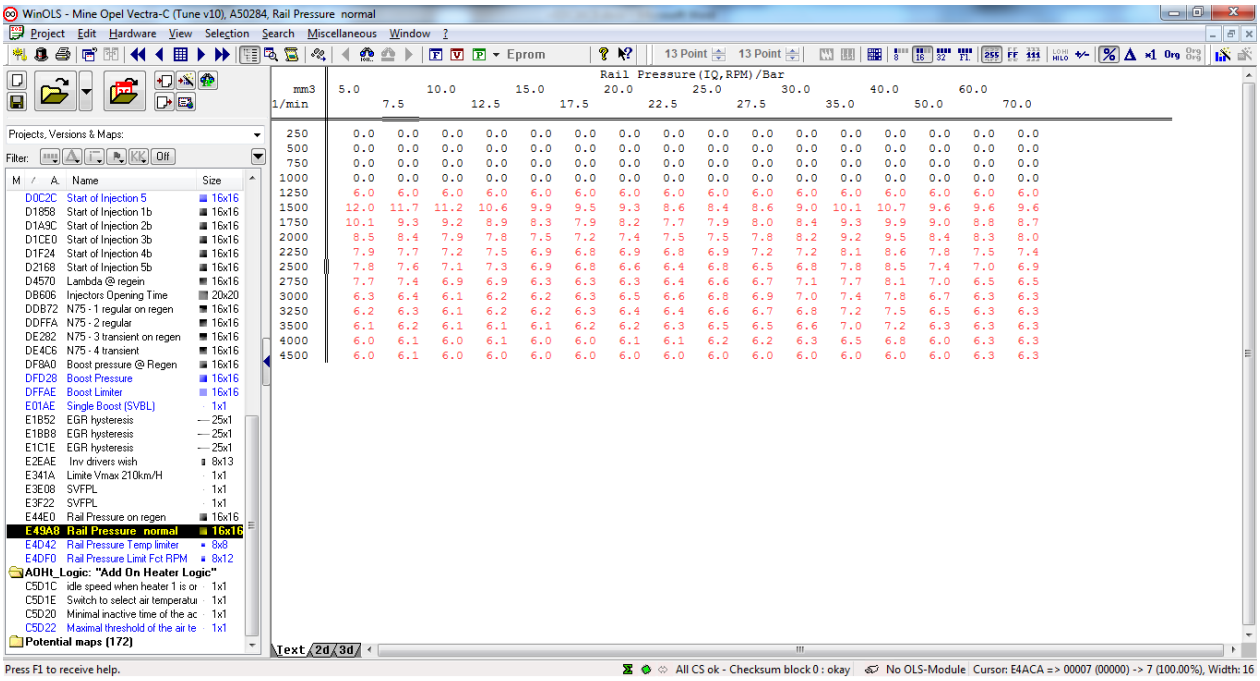
The pro tuner increased all pressure related maps using flat Delta (100bar) over the whole revolution range, same story here. In the beginning (to stay safe) I used +6% (max 1696bar) and extend this all over (1000rpm) the map even for low IQ values.

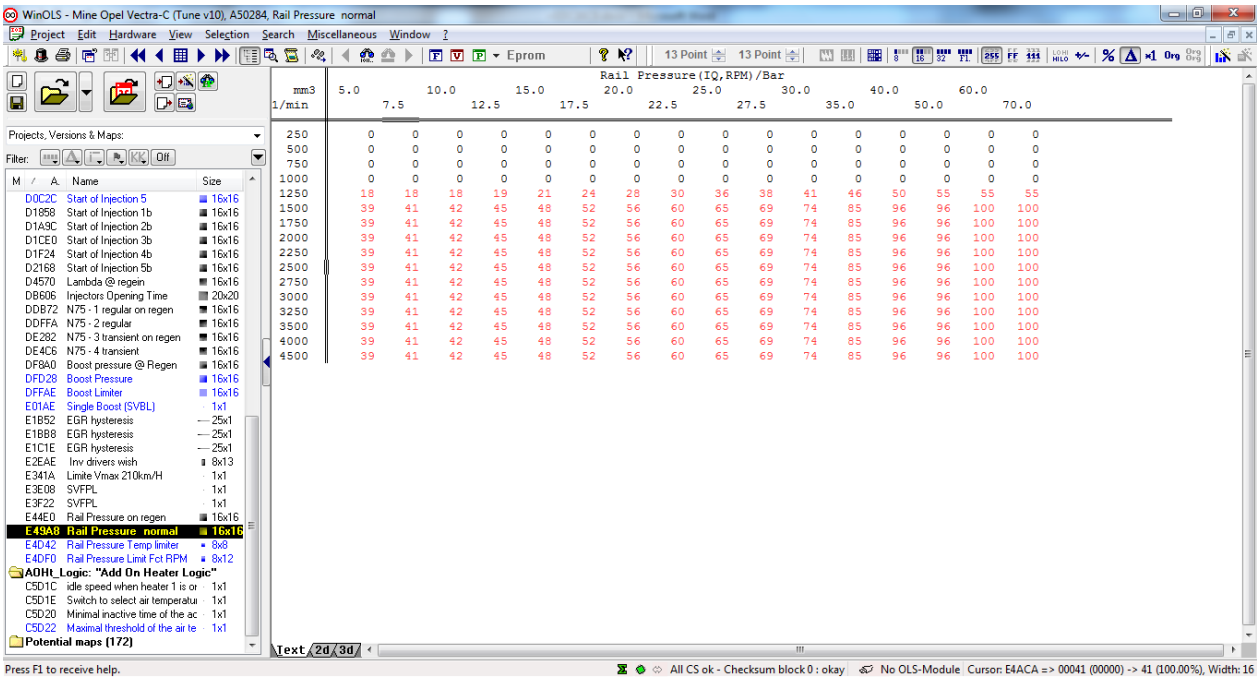
Now I changed my mind. At certain point of back pressure, efficiency of most pumps (especially centrifugal) will drop rapidly. After this point increase of RPMs will only generate more heat, however without increase of the flow rate. This fluid/gas passing through is used also to cool the pump.

Another change of mind☺. Looks like increase of CRP is used to reduce NOx(O2 rich zones) and this cost higher BSFC. So now I use it same as the pro tuner only at high IQ, to advance end of injection.



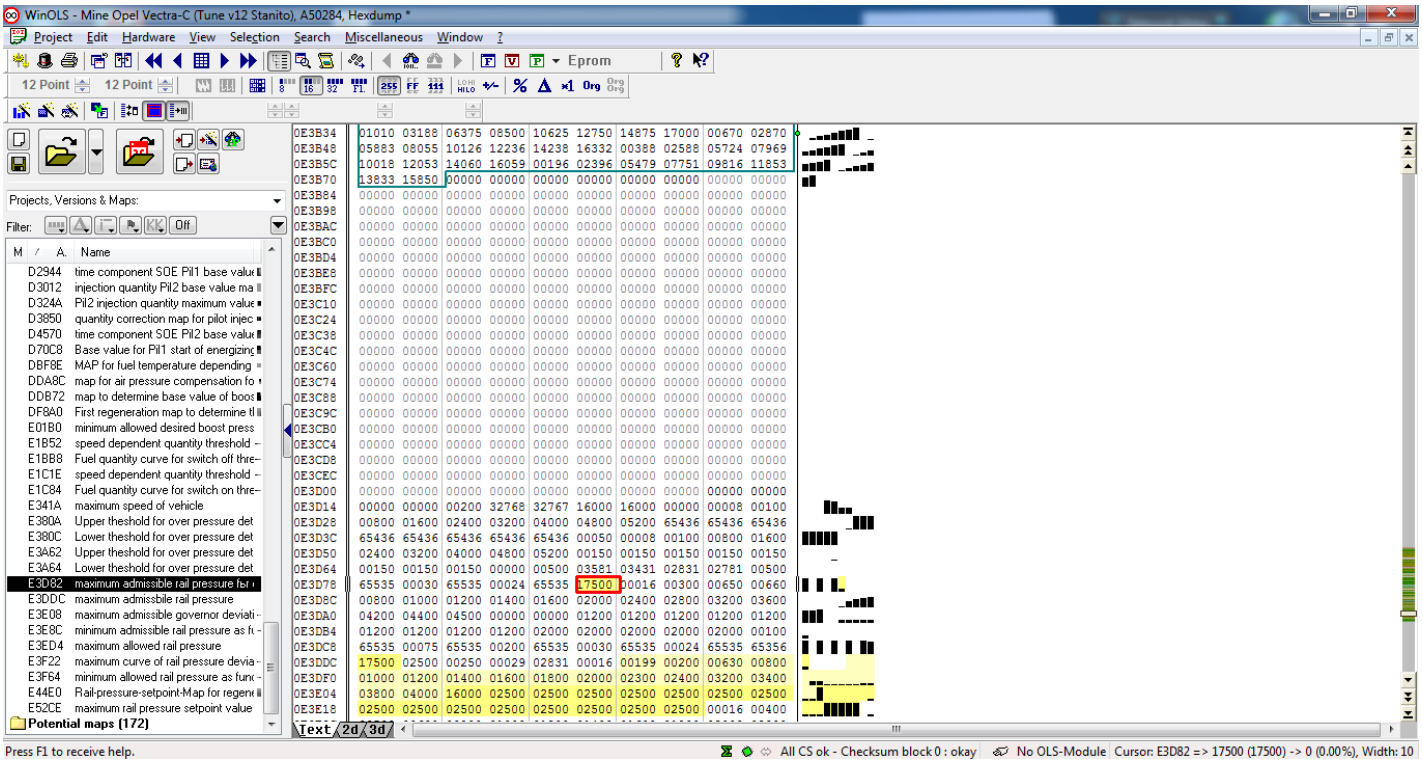
Mine Vectra difference in % and difference in “D”





12. SV Rail Pressure:

This value limits the absolute common rail pressure. This value can be found behind the rail pressure map. There is 3 maps like this. No need to touch them. They are set to 1750bar.



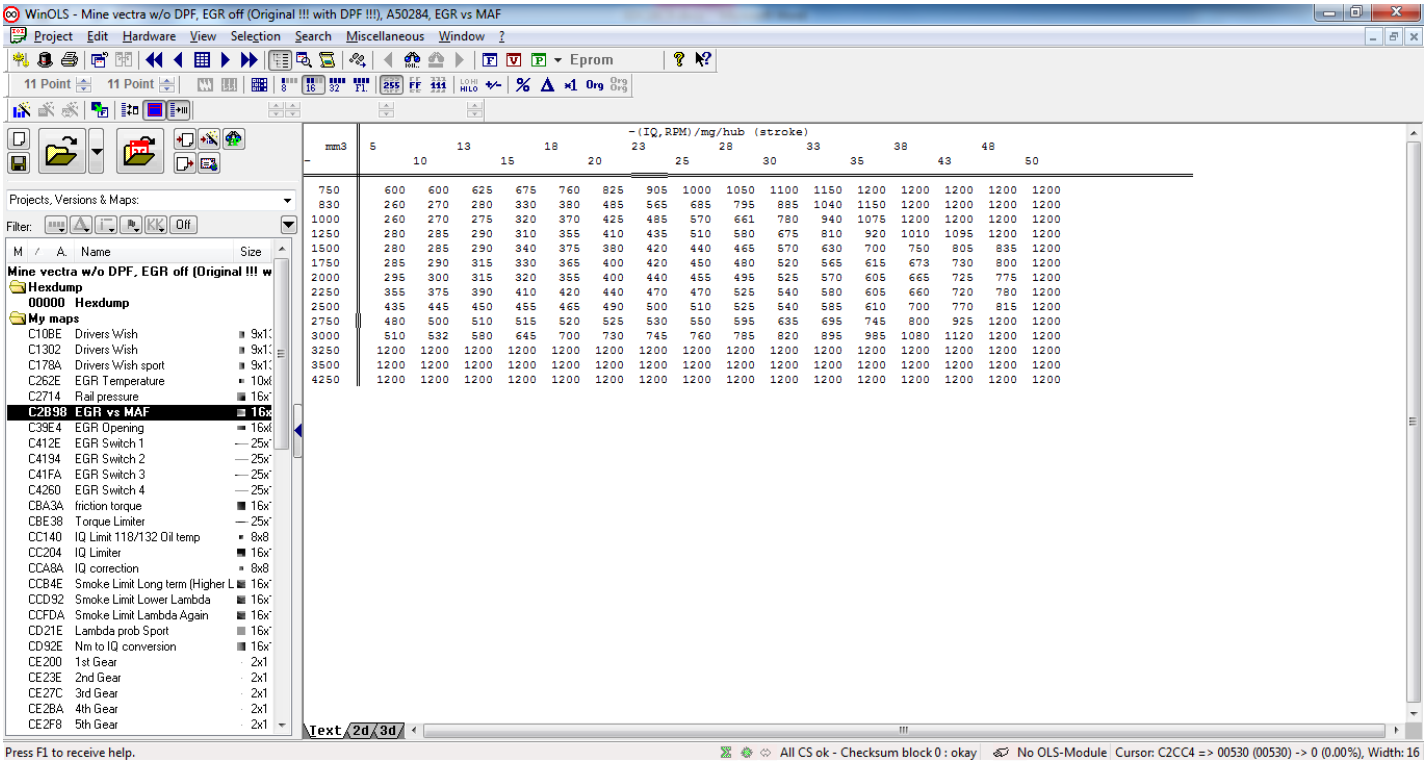
Air related maps

13. EGR vs MAF map:

To prevent clogged intake and avoid future (Swirl flaps, MAP, EGR) problems the EGR map can be simply disabled using switch. However some tuners report less fuel consumption while leaving EGR working but reduced i.e increase allowed MAF. To reduce EGR and allow more air intake we need to increase the allowed MAF in mg/stroke. Do not go over the highest value, in this case it is 1200mg/stroke. On EDC15 this map is used to switch off DPF by setting all values equal to the highest one. Usually same as last column.
The pro tuner did not switch of the EGR neither touch this map.

When reading data from the ECU log, the mass air flow is reported in kg per hour but in hexdump we work in mg per stroke. Converting one value to the other is quite simple:
One full cylinder filling is 1.910 ltr : 4 cyl = 0.4775 liter. Air is about 1290mg per liter.
So we can calculate 0.4775 ltr/stroke * 1290 mg/ltr= 615.975 mg/stroke. However, the cylinder is not fully filled as it has to suck in the air in a limited amount of time (and may get EGR). Therefore the value is a lower. If the turbo would be really working at idle, the air flow could be higher than 616 mg/stroke.

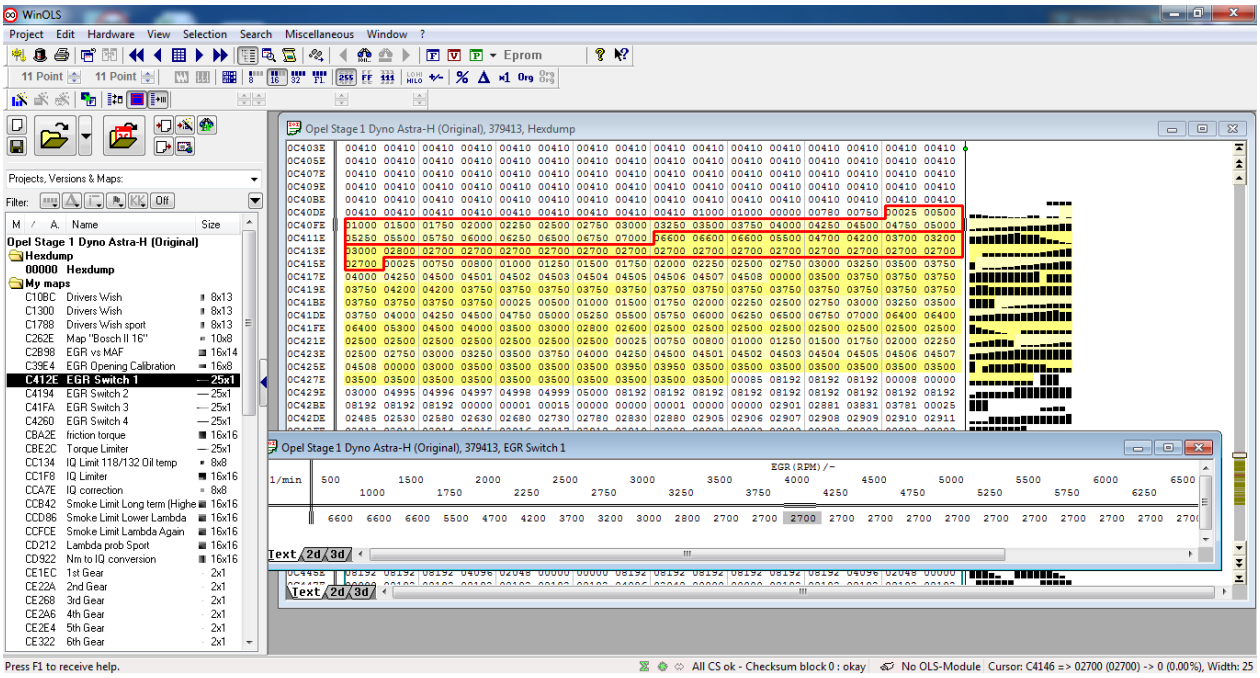
At 900 RPM a 4 cylinder 4 stroke engine makes 900 RPM * 2 strokes/revolution * 60 minutes in one hour = 108,000 strokes. So if the ECU reads 616 mg/stroke at idle, it equals to 108,000 * 616e-6 = 66.53 kg/hour air flow.



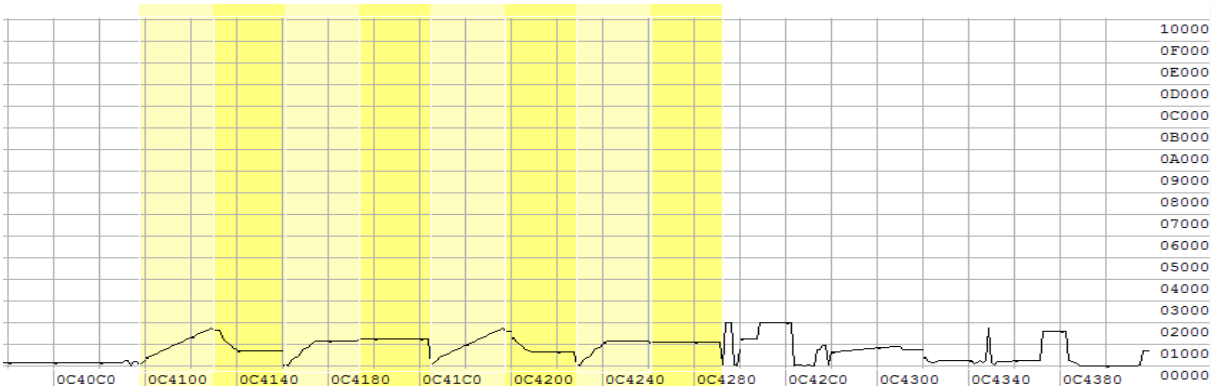
This map will show how much MAF your car used to get. So this can be used as guide for lowering the boost if closing or reducing EGR.

If you like to switch off EGR completely on EDC16, there is no need to touch the above map:

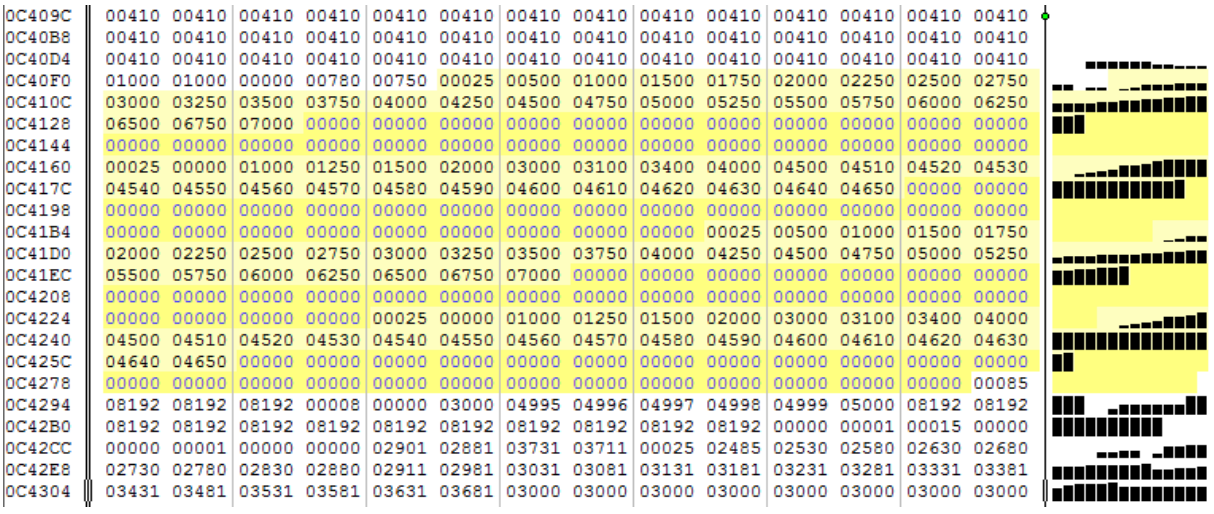
Find the 4 switches shown on the screenshot below. They switch off EGR depending on IQ.



Or find EGR map (Desired air quantity MAF) - *in this file C2B98* Turn on 16bit, HiLo, decimal and 2D mode. Search after EGR map 4 hysteresis (25x1) like on the pictures below



Fill these maps with 0 like on the pictures below



When closing EGR you may need to adjust n75!

a) Looks like in those type of ERG arrangement N75 is used to create back pressure and divert EG flow to intake manifold.
"Even though a variety of measures can be taken, the leading contender is to use a variable geometry turbine (VGT) that can effectively provide the desired EGR driving pressure without substantially sacrificing the performance of the turbocharged engine. In such systems, the EGR control is closely tied to the VGT control"

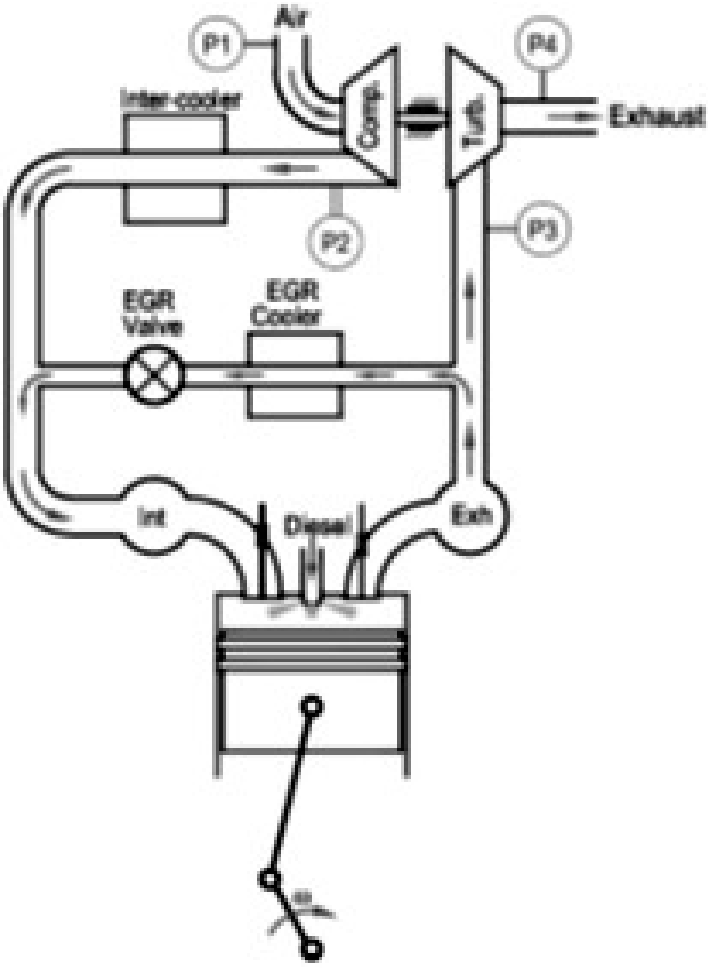


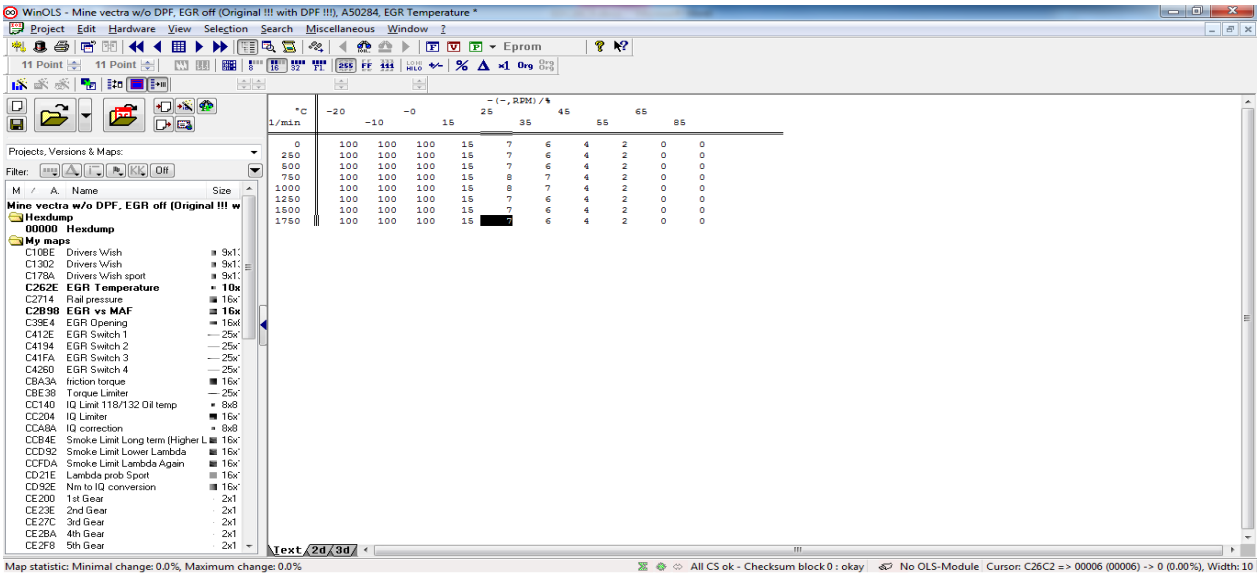
Fig. 3. High pressure loop EGR.

b) Turbine will spool a bit faster - EG directed not to intake manifold but to the turbine side
c) Turbine will spool a bit faster - More air at intake manifold = more EG at exhaust manifold

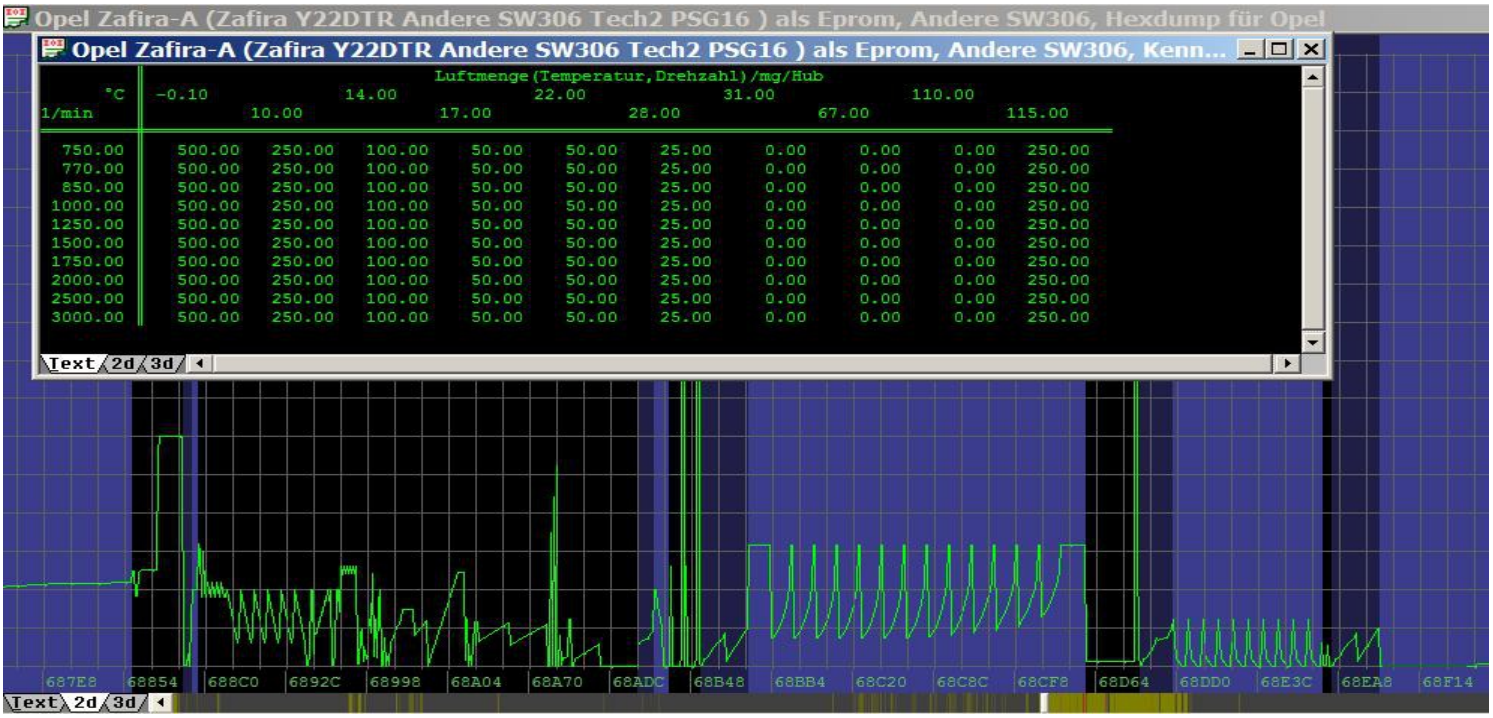
14. EGR vs Temp map (Setpoint generation):

I want to make EGR working only at low Ambient Temperatures.

I`m not sure ho this map work!!! And planning some experiments and find is this correction is additively or multiplicative done.



The EGR-Valve is normaly working between 55°C and 100°C, upper it will be totally closed und lower 55°C -
that´s what it´s difficult to explain because the map values are for internal settings and i don´t know how it could be translated to values that i understand.
But i will show you in PSG16 what´s the same like EDC16 !
My engine Y22DTR runs in idle about 850 1/min that makes approx. 520mg/Hub air mass without EGR.
The desired value of egr map - 850 1/min and 5 mg/Hub IE is 300mg/Hub air mass, so the EGR valve opens so long till the measured air mass is about 300 mg/Hub.
Now comes the coolant temp. correction map - see egr.jpg



850 1/min and 10°C coolant temperature = 250mg/Hub air mass to add to the desired EGR value =
300mg/Hub + 250mg/Hub =550mg/Hub air mass to measure
So idle without EGR = 520mg/Hub and corrected EGR value 550mg/Hub = -30mg/Hub = EGR CLOSED !!!
The only difficult thing is to hold this values close together otherwise you get MIL
Now you have to play with your car a little and find a good solution that will make this function you want but it will work !
I hope you understand the function of this map like i explained and you ignore my bad english.
btw: This was the way i was closing the egr in my y20dtl (EDC15M) zafira till i found a better way !

15. Turbo (Boost request) map:

"The turbo on this car, a GT1749V, can handle a max boost of around 2650mbar. So the max value in this map may be 2600mbar." This turbo pressure is only for the 150hp version. The lower hp versions have also lower turbo pressure! As per Garrett this turbo can support around 175Hp, so I would not advise you going to 2600mbar. You can assume that the turbo pressure may be increased by around 7% max.

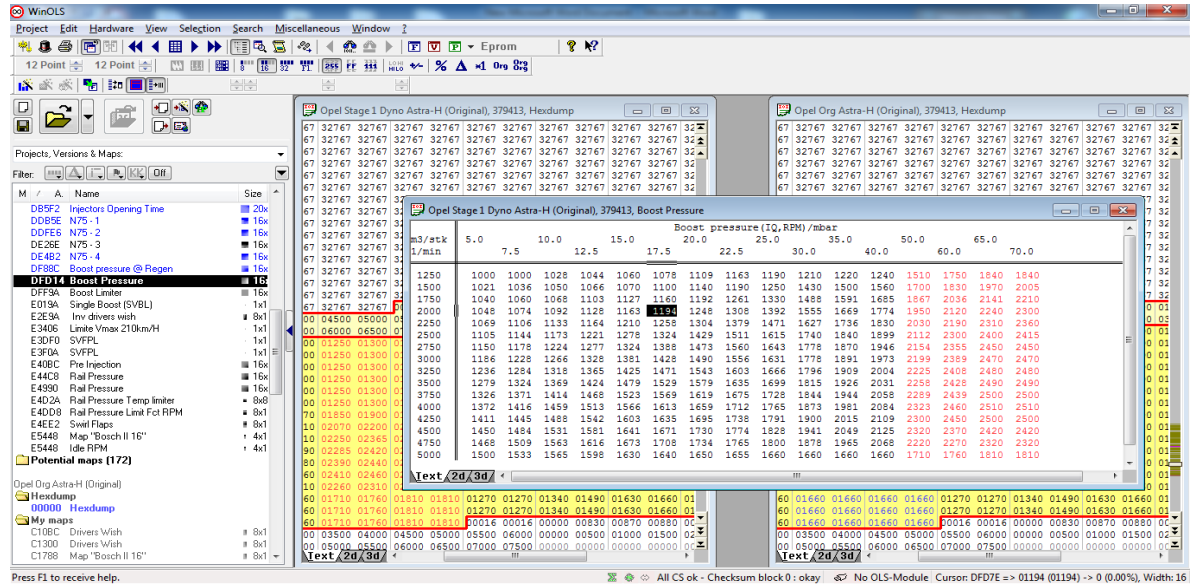
Since we are only tuning for max power only the 3-4 most right columns has to be changed. As you can see the boost goes up to max 2510mbar. Pro tuner work with fixed Delta and increase boost request for 70mm3 IQ by 150mbar. "Maybe use of flat value from the lowest to the highest rpms is not the best approach. I choose to increase mine working in %".

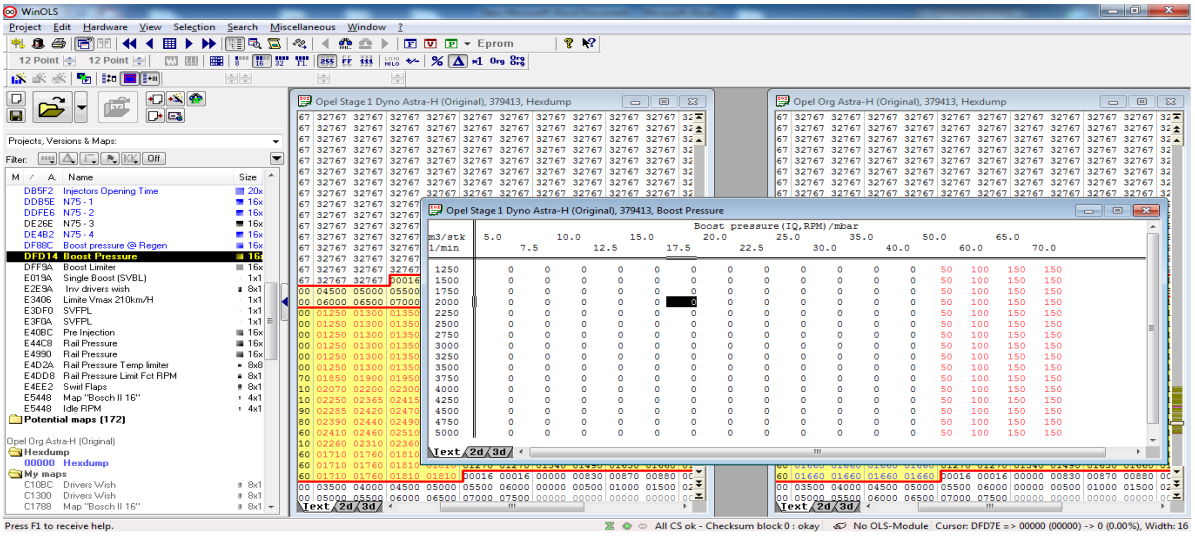
It was before. As I said above Maybe ☺. However maybe it is better to request more boost while compressor work in its high efficiency islands, instead out of them and getting over speed to reach required Pressure Raito. In my last tune I also use Delta values, trying to get higher boost when compressor is not on its maximum.
At the extreme upper right corner I copy some cells from Astra file. Probably to avoid surges, at this area stock manual Astra request up to 50% more than my stock automatic Vectra.

As you can see the axis value goes up to 70mm3/stroke. As we will inject about 80mm3/stroke (by my logging, with 15% increase) you can rescale axis and boost request. Pro tuner did not although he did 20% increase of IQ...

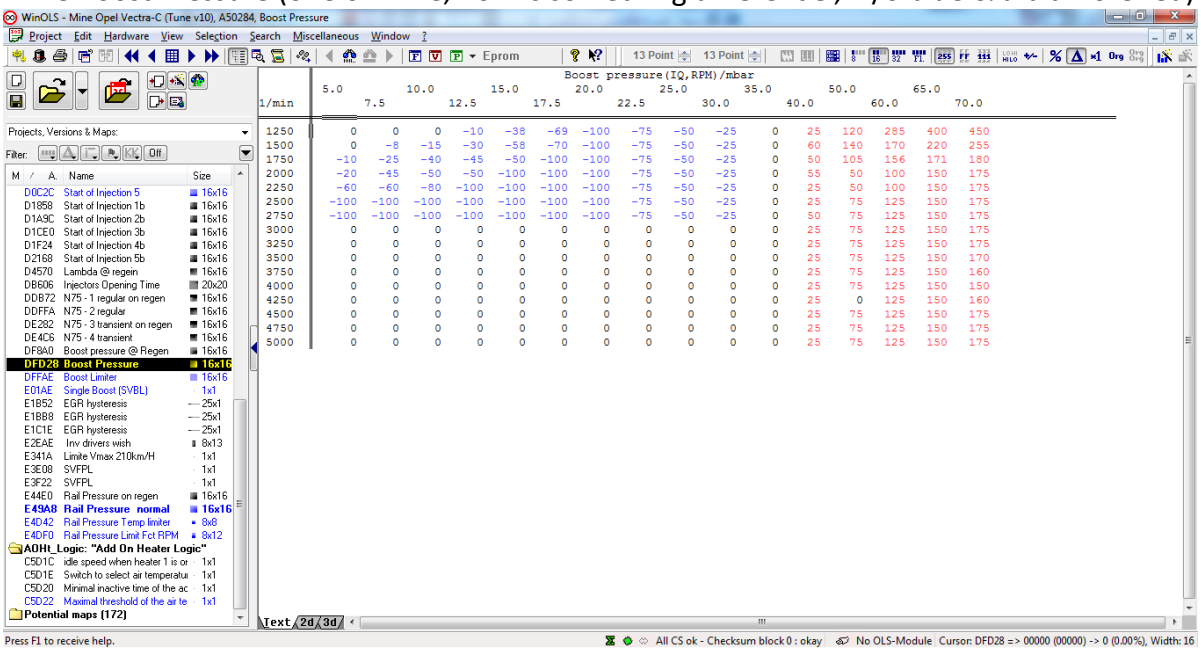
Economy tuning is much more complicated… At low RPM and IQ, EGR restrict MAF to 200 – 500 mg/stroke.
Naturally aspired 1.91ltr engine will get 0.48ltr/stroke * 1290mg/ltr = 619 mg/stroke.
Applying correction for volumetric efficiency of the engine as a function of engine speed 619 mg/stroke * 0.90 = 557.1 mg/stroke (+/- some error, should be the reading from MAF sensor)
So why should restrict natural aspiration by EGR and request boost for IQ less than 25mm3/stroke (and 1mm3 is only 0,86mg). Many tuners report better fuel economy with decreased boost request. **However I doubt that requesting 0.01mbar more at compressor side will bring more pumping losses (less beneficial) than 10 bars more requested at CRP**. So now I give (EGR off) and force (higher rqst at high IQ) my engine to breathe more.
N75 should also be adjusted to avoid spikes and lower back pressure on the exhaust system.
In order to calculate actual MAF from Boost pressure should take in account also:

- map for air pressure compensation for boost pressure control
- map to determine base value of desired boost pressure (15. **Boost request**)
- curve for air temperature dependent factor for boost pressure control
- maximum allowed desired boost pressure according to air pressure (16. **Boost limiter map**)
- maximum allowed desired boost pressure (17. **SVBL**)
- overall efficiency turbocharger
- Default value environment air pressure for turbo model - 980mbar
- induction volume (effective volume between turbocharger and mixing point) - (lag from MAP to MAF control)
- Exhaust gas back pressure MAP
- correction factor for compensation of the dependency of the volumetric efficiency of the gas temperature upstream of the inlet
- volumetric efficiency of the engine as a function of engine speed and current injection quantity (This is the other map playing major effect, for mine 1.9cdti 16v correction is 86 to 93%)
- correction factor for volumetric efficiency as a function of engine speed and relative swirl valve position
- Factor for correction of the torque loss due to exhaust-gas back pressure caused by installed particle filter
- Limitation below of the torque loss due to exhaust gas back pressure caused by installed particle filter



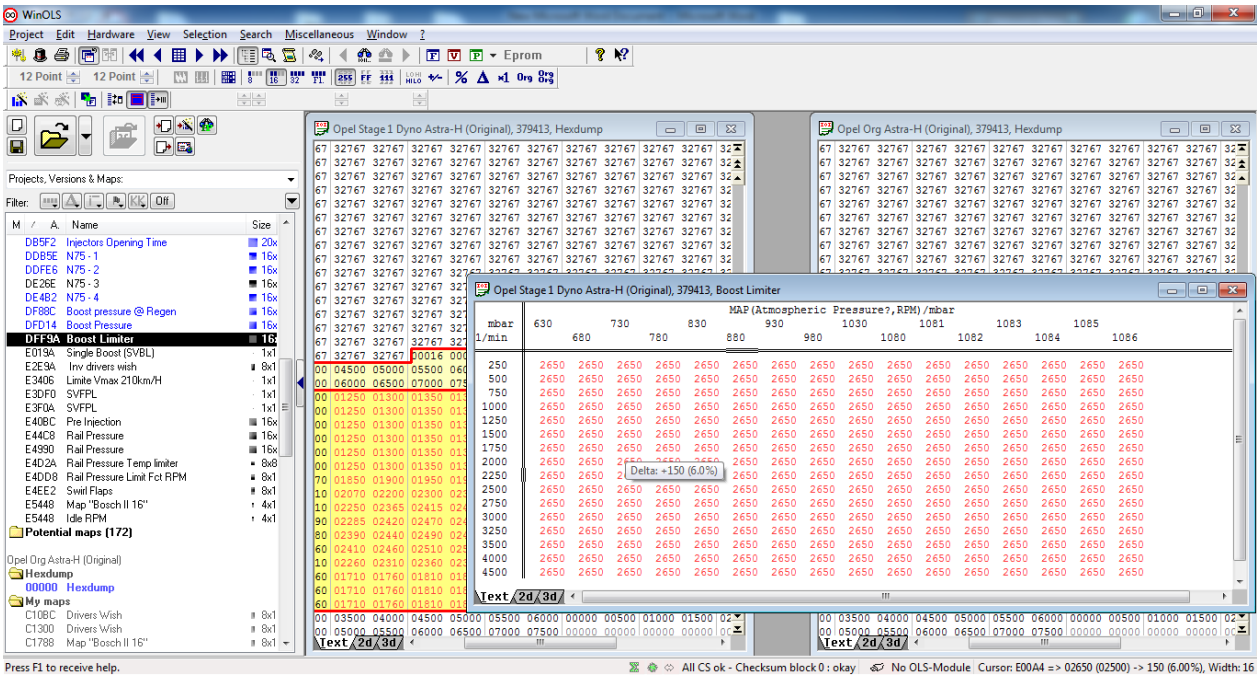


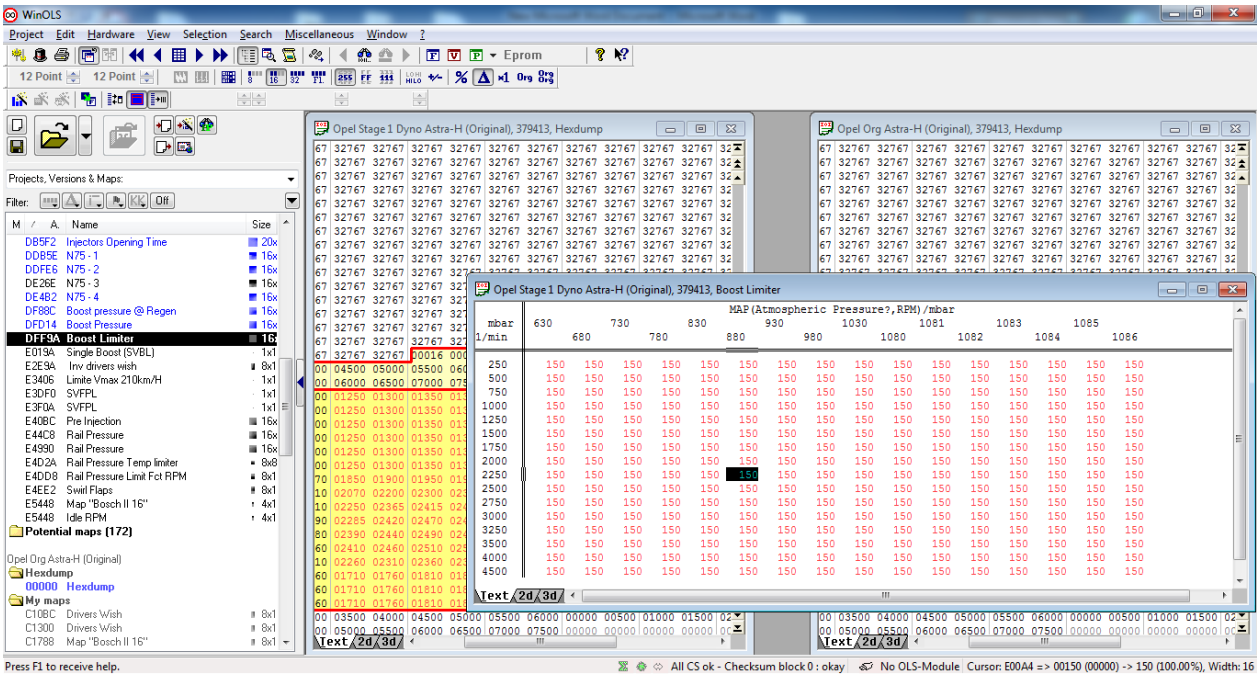
Mine Boost Pressure (one of mine, now is something different☺, w/o blue & a bit more red)



16. Turbo (Boost) limiter map:

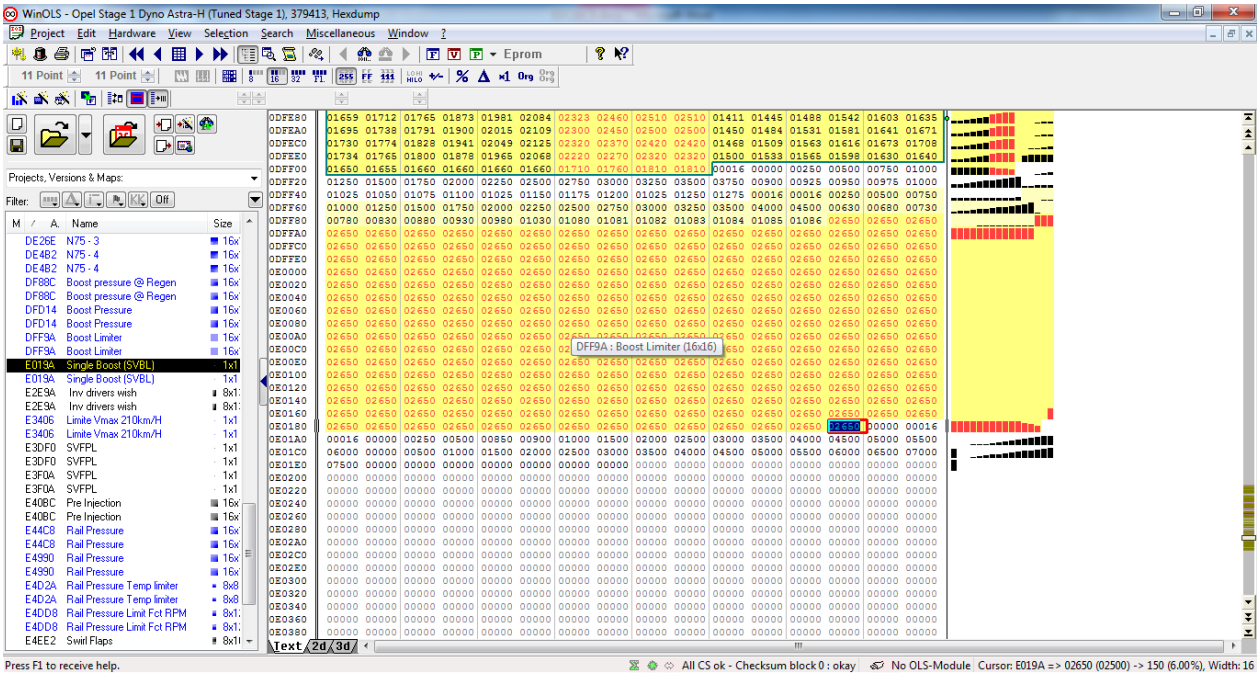
At this point we have set the boost up to 2513 mbar in the turbo map, and prevent boost spikes by lowering the N75 map. But the boost limiter map will limit the 2513mbar back to 2500mbar as you can see in picture. Pro tuner increase boost request by 150mbar and so he did for the boost limiter. This way margin between boost request and limiter stay untouched. As I used 6.5% for my boost I used same value for the boost limiter.
We need to change that values the same way as the turbo map, even a bit higher because this is the limiter. Since we only drive at sea level (1013,25hpa), there is no need to adjust the car at 900hpa and lower (or you live at more than 1000metres above sea level). Stock Opel have same value all over the range despite of atmospheric pressure.





17. **Single values boost limiter***:*

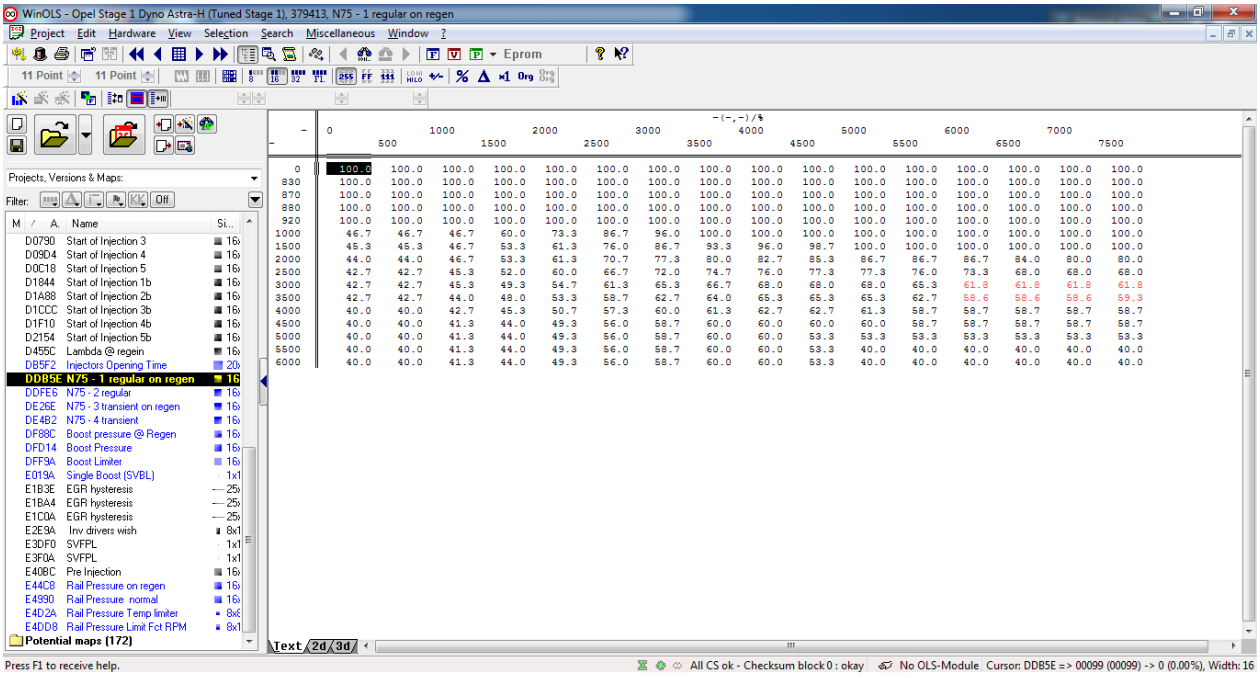
At this point we have set almost everything to get a higher boost except the absolute limiter.
That's the last one we need to change. Opel engineers use same value for SVBL and boost limiter despite the atmospheric pressure. So just use the same stock +6.5% (on my last tune Delta=175mbar). As per some tuners this value has to be a bit (read 50mbar) higher than the highest turbo map value.

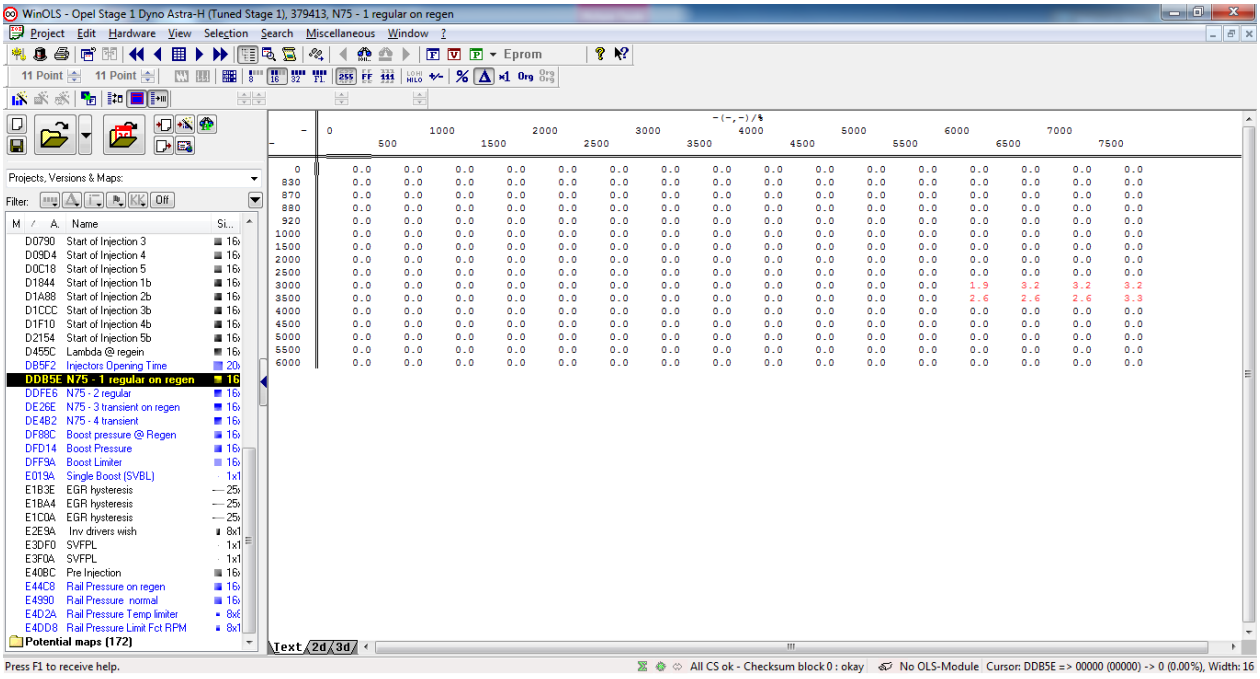


18. Turbo vanes (N75) map:

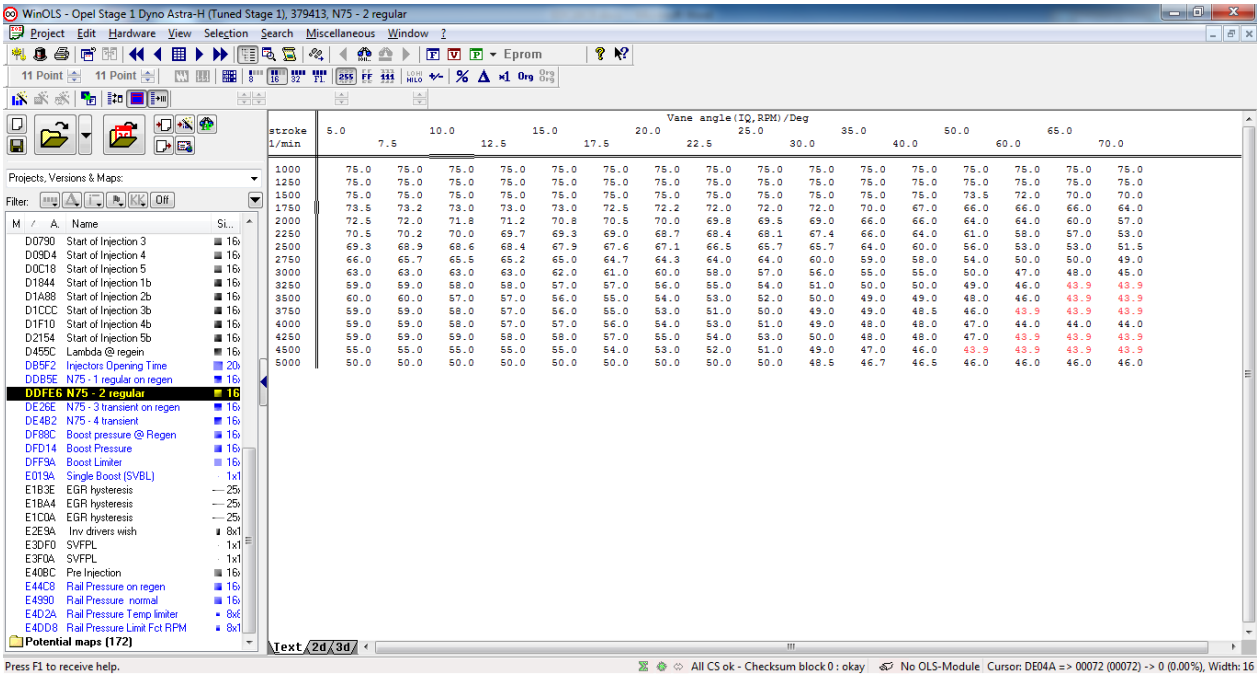
The N75 map controls the vanes inside the turbo, and when increasing IQ (or removing DPF) needs to be reduced to prevent turbo spiking. As we did not rescale boost map IQ axis will not rescale N75 axis neither. If you did so, better match N75 IQ axis to boost map IQ axis.
As a rule you can decrease the values from 1500-5000rpm at high IQ's by 8%. This is depending on the car, and how much boost spikes you have… still got boost spikes… reduce the map. You can see that the tuner choose to change all the maps same why, even those that are not in use (Astra didn`t have DPF). He did the same for the rail pressure (but not for lambda) designated for DPF regeneration.
After a lot of logging I could not find any benefits from lowering the N75 and now I running with stock.

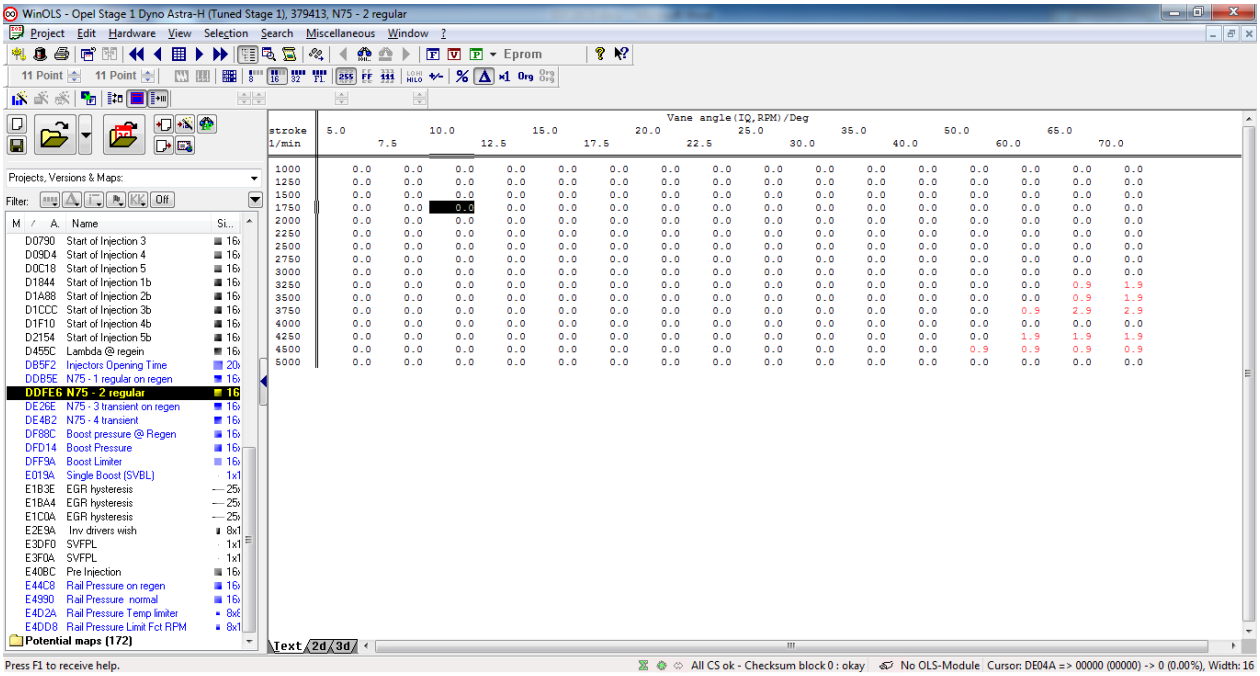
Regular N75



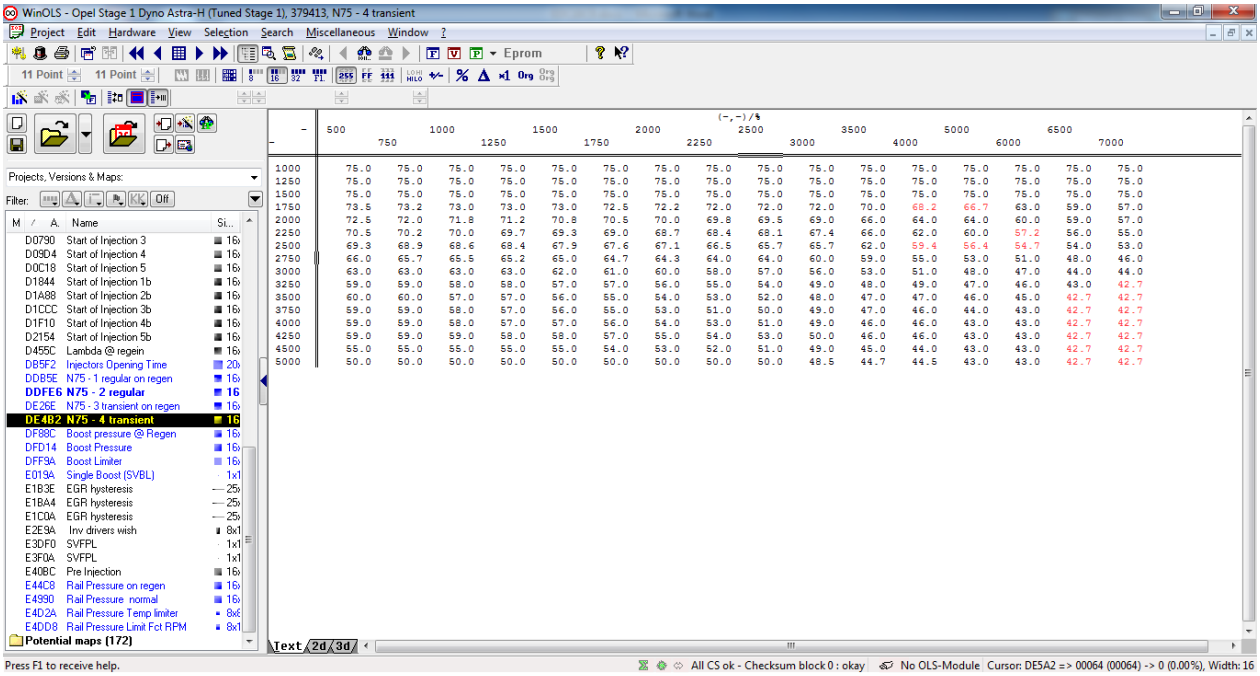


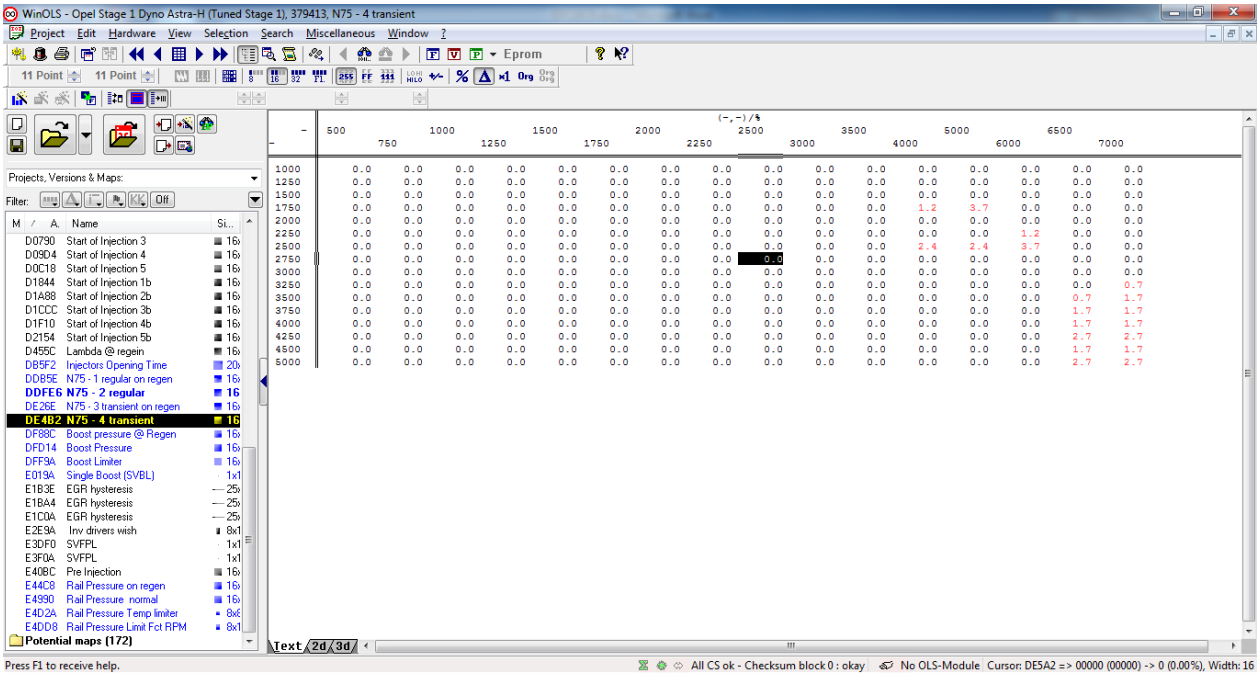
Regular N75 during DPF regeneration





Transition N75 during

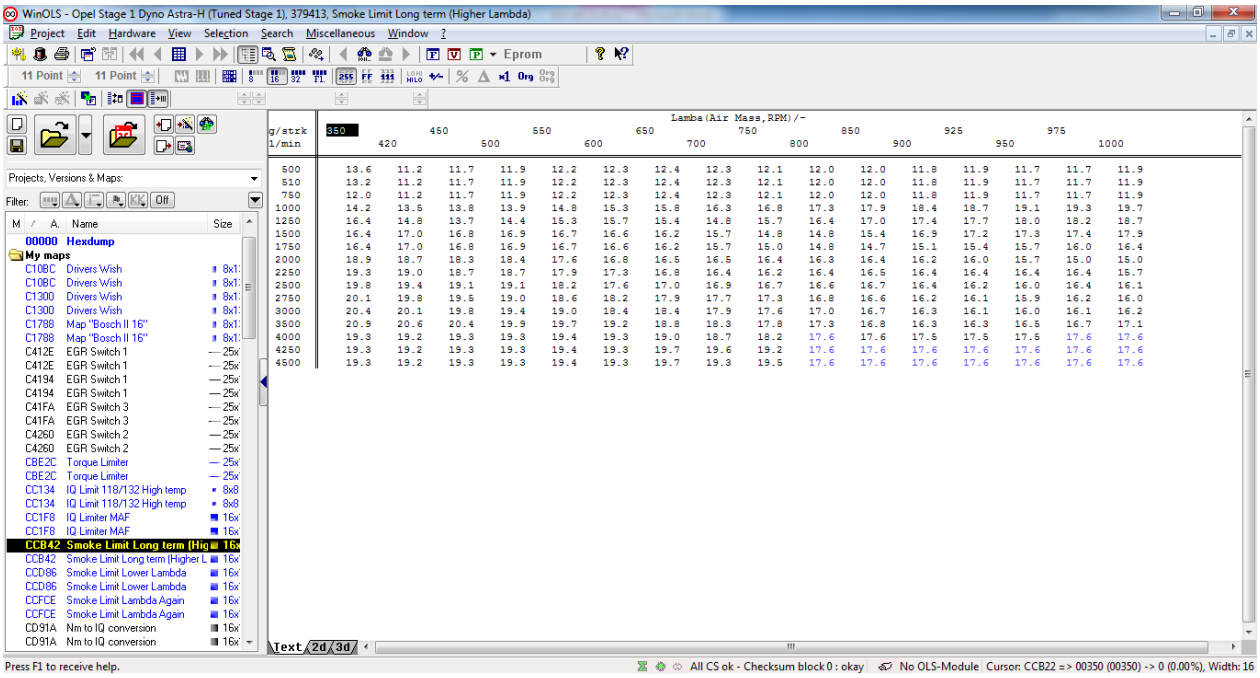


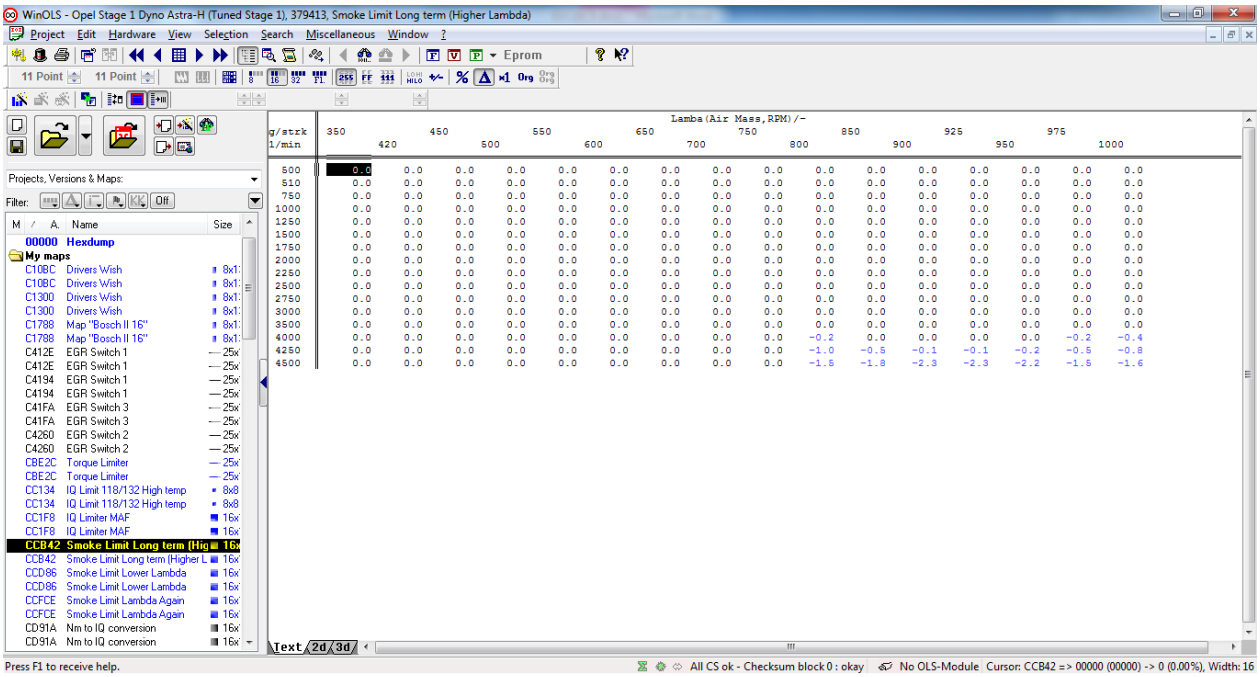


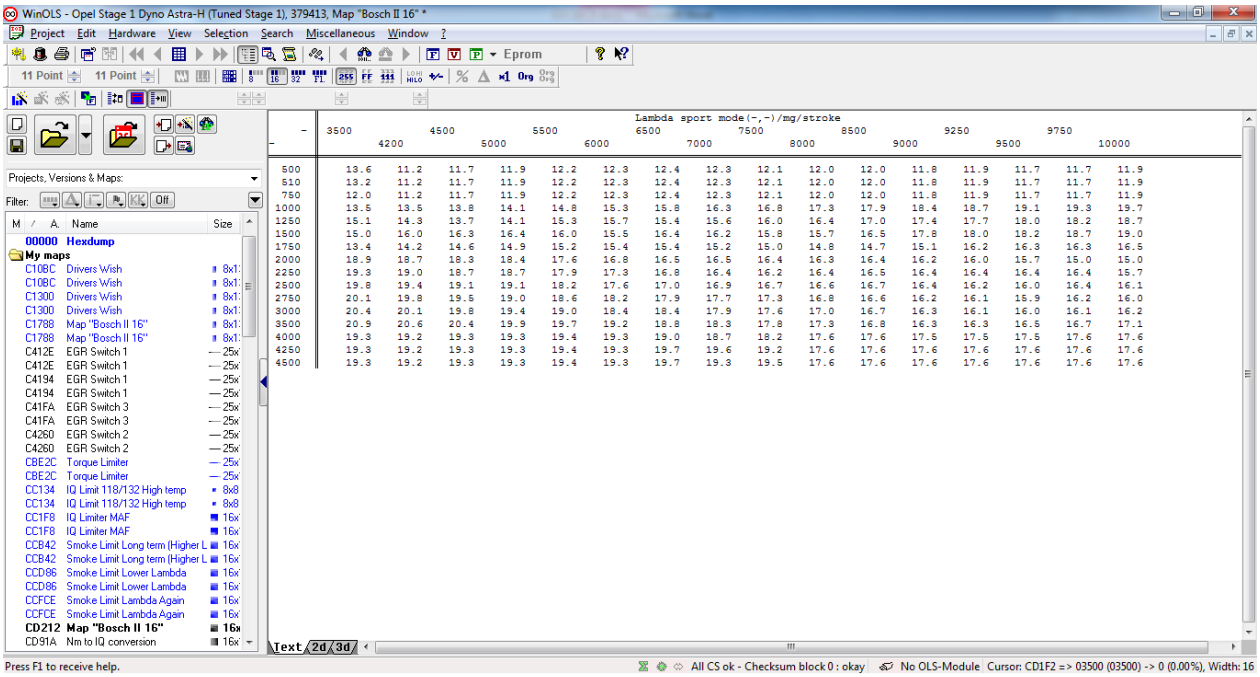
19. Lambda:

Pro tuner change very few values at high rpm and MAF, In fact he just copy the Sport Button lambda for high RPM and MAF. He left the sport button lambda unchanged.

My car don’t have sport button so I choose to copy whole Sport button lambda map, over the regular lambda map. To avoid being too smoky I set the minimum AFR value to 14,5







-	3500	4200	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000	9250	9500	9750	10000
500	13.6	11.2	11.7	11.9	12.2	12.3	12.4	12.3	12.1	12.0	12.0	11.8	11.9	11.7	11.7	11.9
510	13.2	11.2	11.7	11.9	12.2	12.3	12.4	12.3	12.1	12.0	12.0	11.8	11.9	11.7	11.7	11.9
750	12.0	11.2	11.7	11.9	12.2	12.3	12.4	12.3	12.1	12.0	12.0	11.8	11.9	11.7	11.7	11.9
1000	13.5	13.5	13.8	14.1	14.8	15.3	15.8	16.3	16.8	17.3	17.9	18.4	18.7	19.1	19.3	19.7
1250	15.1	14.3	13.7	14.1	15.3	15.7	15.4	15.6	16.0	16.4	17.0	17.4	17.7	18.0	18.2	18.7
1500	15.0	16.0	16.3	16.4	16.0	15.5	16.4	16.2	15.8	15.7	16.5	17.8	18.0	18.2	18.7	19.0
1750	13.4	14.2	14.6	14.9	15.2	15.4	15.4	15.2	15.0	14.8	14.7	15.1	16.2	16.3	16.3	16.5
2000	18.9	18.7	18.3	18.4	17.6	16.8	16.5	16.5	16.4	16.3	16.4	16.2	16.0	15.7	15.0	15.0
2250	19.3	19.0	18.7	18.7	17.9	17.3	16.8	16.4	16.2	16.4	16.5	16.4	16.4	16.4	16.4	15.7
2500	19.8	19.4	19.1	19.1	18.2	17.6	17.0	16.9	16.7	16.6	16.7	16.4	16.2	16.0	16.4	16.1
2750	20.1	19.8	19.5	19.0	18.6	18.2	17.9	17.7	17.3	16.8	16.6	16.2	16.1	15.9	16.2	16.0
3000	20.4	20.1	19.8	19.4	19.0	18.4	18.4	17.9	17.6	17.0	16.7	16.3	16.1	16.0	16.1	16.2
3500	20.9	20.6	20.4	19.9	19.7	19.2	18.8	18.3	17.8	17.3	16.8	16.3	16.3	16.5	16.7	17.1
4000	19.3	19.2	19.3	19.3	19.4	19.3	19.0	18.7	18.2	17.6	17.6	17.5	17.5	17.5	17.6	17.6
4250	19.3	19.2	19.3	19.3	19.4	19.3	19.7	19.6	19.2	17.6	17.6	17.6	17.6	17.6	17.6	17.6
4500	19.3	19.2	19.3	19.3	19.4	19.3	19.7	19.3	19.5	17.6	17.6	17.6	17.6	17.6	17.6	17.6

GLOSSARY

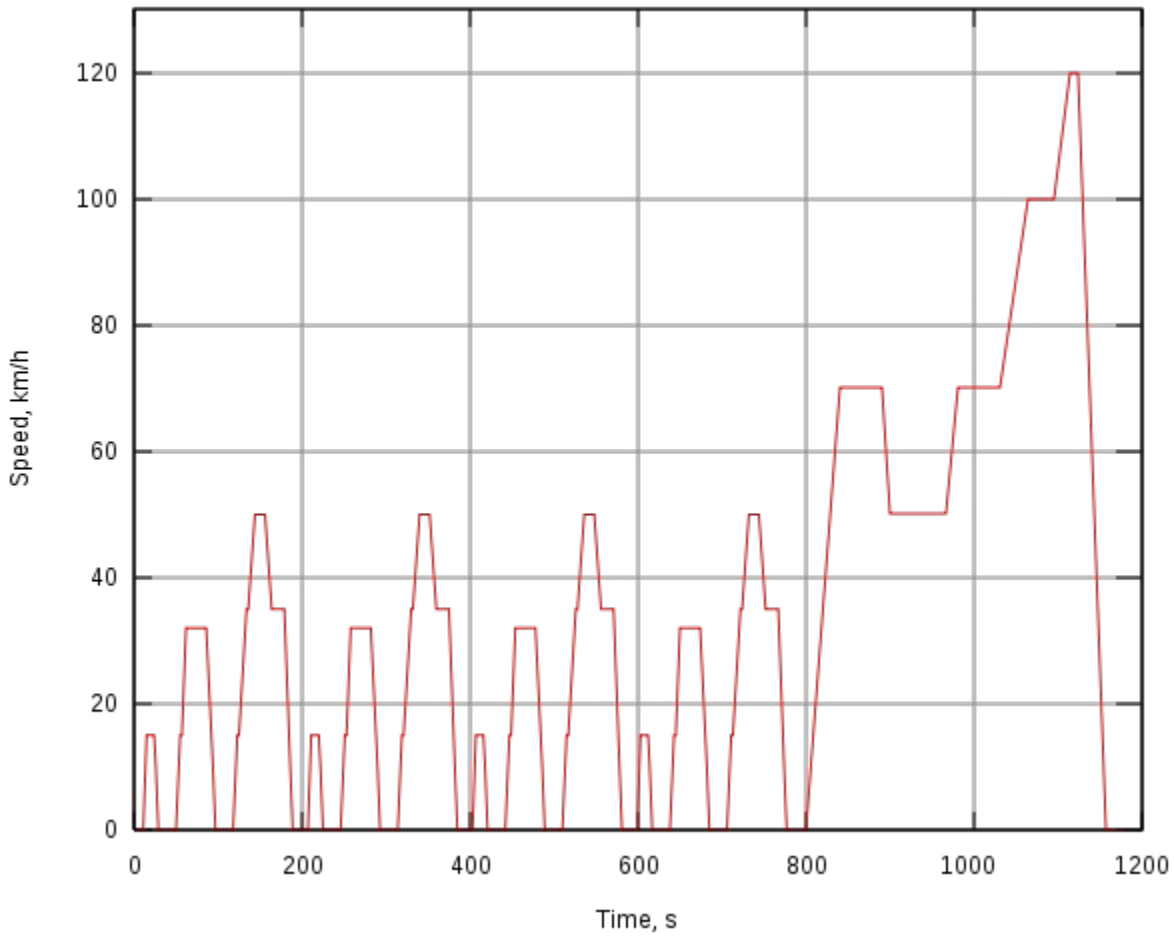
IQ = Injection Quantity
SOI = Start Of Injection = SOE = Start Of Energizing
EOI = End Of Injection
CRS = Common Rail System
Mg = milligrams
Str = Engine Stroke
°CR = Degree Crankshaft Rotation
°C = Degree Celcius
rpm = Engine revolutions per minute
BTDC = Before Top Dead Center
ATDC = After Top Dead Center
Nm = Newton metres (Torque)
Mbar = Millibar (pressure)
BMEP = break mean effective pressure
CA = crank angle
CO = carbon monoxide
ECM = engine control module
EGR = exhaust gas recirculation
MAF = mass air flow sensor
HCCI = homogeneous charge compression ignition
NOx = oxides of nitrogen
PM = particulate matter
SI = spark ignition
TDC = top dead center
THC = total hydrocabon
VGT = variable geometry turbine
WGT = Waste gate turbine

Tips

1. All 0 maps are ignored
2. For everything higher than max, last known value is used.
3. Transient VNT maps are used when pedal change is more than 20% in one second.
4. VNT maps are only used in open loop mode, when closed loop kicks in PID controller takes over.
   If actual boost is too far from requested when PID takes over, you get boost oscillation, because PID control is slow.
5. Lambda maps limit IQ in relation to air mass mg/hub (hub means stroke), to keep the intended AFR.
6. 1ltr diesel is about 0.85 kg i.e 100mm3 are 86mg
7. According to the CRC Handbook of Chemistry and Physics, the density of dry air at 20 degrees C at 760 mm of mercury (one atmosphere of pressure) is 1.204 milligrams per cubic centimeter. 1 liter = 1000 mL = 1000 cm^3 ; (1.204 mg / cm^3) * 1000 cm^3 = 1204 mg = 1.204 grams
8. Lambda factor for EDC16 is 0.0145 as per Bosch EDC16 manual
9. You could increase rail pressure up to 1750 bar, 1,9DTH/CDTI engine has 1800-bar rail sensor.
10. GT1749V, can handle a max boost of around 2650mbar
11. Make torque limiter linear. The horse power comes in high RPM. If you increase suddenly the torque the clutch and the flywheel will die.
12. .. most work in good tuning goes to proper VNT tuning so your boost does not oscillate. There are 4 VNT maps in this ecu, 2 normal and 2 on regen. Normally you need to LOWER them on tuned car by 2 or 3%. You need logs for exact match as every car is little different.
13. Both of the boost readings they are in mBar and Absolute
14. 1.18 *wheel power=flywheel power; Usually RWD-lose 10%; FWD-lose 15%; AWD-lose 20%; Auto-lose 5%
15. And the easy way to adjust the AFR without wideband AFR sensor is to observe the sooth from the exhaust. When it starts "smoking" - you need more air. Or more advance.
16. PD duration calibration - Make an interpolation or add approximately 5 degrees for each 5mg...
17. If the engine is running in low load you'll get white/grey smoke from late injection. Because the cylinder and exhaust gas is too cold to complete the combustion.
18. Since O2 has a moleculare weight of 32, and air 29, on a mass/mass basis, this is 0.21 x 32/29 = 0.232 kg O2/ kg air. That will be independent of temperature and pressure.
19. **Petrol gasoline, or benzin** is composed of a mixture of 2,2,4-trimethylpentane (an isomer of octane C8H18 [octane rating 100]) and n-heptane (C7H16 [octane rating 0]). Example of octane rating, petrol with the same knocking characteristics as a mixture of 95% iso-octane and 5% heptane would have an octane rating of 95.
20. **Diesel** is composed of about 75% saturated hydrocarbons (primarily paraffins including n, iso, and cycloparaffins), and 25% aromatic hydrocarbons (including naphthalenes and alkylbenzenes). The average chemical formula for common diesel fuel is C12H23, ranging approximately from C10H20 to C15H28.

Fuel	Combustion formula	Density kg/l (lb/US gal)	CO2 kg/l (lb/US gal) emissiones
Petrol gasoline	2 C8H18 + 25 O2 --> 16 CO2 + 18 H2O + 2636 kcal	0.7197 kg/l (6.073 lb/gal)	2.3035 kg/l (19.24 lb/US gal)
Diesel	4 C12H23 + 71 O2 --> 48 CO2 + 46 H2O + energy	0.832 kg/l (6.943 lb/gal)	2.6256 kg/l (21.91 lb/US gal)
Biodiesel C19H34O2	C19H34O2 + (53/2) O2 --> 19 CO2 + 17 H2O + energy	0.889 kg/l (7.42 lb/gal)	2.839 kg/l (23.69 lb/US gal)
Biodiesel C20H40O2	C20H40O2 + 29 O2 --> 20 CO2 + 20 H20 + energy	0.884 kg/l (7.38 lb/gal)	2.816 kg/l (23.5 lb/US gal)

21. New_European_Driving_Cycle – http://en.wikipedia.org/wiki/New_European_Driving_Cycle



22. Fuel needed to reach torque target

<u>180 hp @ 3500rpm (0.38 lb hp hr)</u>
0.38 lb hp hr = 0.006333' lb hp min
180hp * 0.00633 = 1.14 lb min fuel
1.14 * 1000000 / 2.204 = 517,241 mg
517,241 / **4 cylinder** / (3500 rpm / 2 strokes) = **<u>73.89 mg/stroke</u>**
180hp * 5252 / 3500 rpm = 270 lb ft
270 lb ft = 73.89mg/str

Lets see how much fuel the same torque at different rpm requires....
270 lb.ft * 2000rpm / 5252 = 102.818hp @ 2000rpm

<u>102.818hp @ 2000rpm (0.38 lb hp hr)</u>
102.818hp * 0.00633 = 0.65118 lb min fuel
0.65118 * 1000000 / 2.204 = 295,454 mg
295,454 / **4 cylinder** / (2000 rpm / 2 strokes) = **<u>73.86 mg/stroke</u>**

Hence if the brake specific fuel consumption remains constant..
..mg/str is proportional to torque.

23. Density of air ρ vs. temperature °C

°C ..... ρ in kg/m^3
−10 ..... 1.342
.− 5 ..... 1.317
....0 ..... 1.292
.+ 5 ..... 1.269
+10 ..... 1.247
+15 ..... 1.225
+20 ..... 1.204
+25 ..... 1.184
+30 ..... 1.165

Air at 0 degrees Celsius has a density of 1.292 kg/m^3 = 1.292 g/L = 0.001292 kg/dm^3 = 0.00001292 kg/L = 0.00001292 g/cm^3 = 0.00001292 g/mL.

24. I mean that to help with NOX gas reduction in cruise the manufacturers lease the SOI retarded but allow a small amount more advance to help with acceleration. As rightly said the dynamic advances up during acceleration because normal SOI map is retarded from optimum to reduce NOX gas. But they know that its retarded state is not good enough for transient or acceleration conditions.

Review

Had a good look at the file and I have to say it is way better than many of the "pro" tunes I have seen posted on the forums or read from actual tuned cars. I would have done it a bit different, don't know if better, but different

What I like about the tune is that there are none nonsense adjustments done - the guy had a keep it clean and simple approach. The things that caught my attention are not stupid, only debatable. Many of the tunes I have seen have stupid changes, which you can't explain only by tuning approach. I think we have to agree that there are many tuning approaches and many different desirable results.

For instance you may want to squeeze every power there is or you may wish to play it safe. I personally don't like very aggressive torque limiters from low rpm, because in my opinion it is unhealthy for the clutch and for the dual mass flywheel. So I don't increase the torque figure by much in my mods, I tend to increase the top end of the rpm range more, to get more horse power. While other tuners simply say - replace the clutch and dmf if it starts to slip/vibrate and if the oem clutch isn't strong enough - replace it with something else.

The other point is what the customer expects. If you manage to explain him, that a lower torque increase will be better for his cars it is fine. But he may compare your tune with a harder tune and not be happy with the results, not thinking about the car. I have also had requests for a very strong tune, for a cars with 450 km on the odometer. As for driver wish maps - you can increase only the 100% end and use the extra power only when needed, you can increase the lower end - the car will feel more lively, but should produce higher fuel consumption. You can decrease the lower end for economy, BUT... I have had customer, that say: "I never use more than 70 percent of accelerator, because it surges the engine" and suddenly with the giving it max at 100% approach I am the worst tuner in the world because the car goes exactly the same. After a few similar experiences I increase the DW at almost the whole range by some percent, just for the car to "feel" more alive. I have done experiments with lowering the DW on the lower part - customer said that the car was very lazy, he pressed the pedal too much and fuel consumption increased. So it is not always the way you intend things to happen.

As for the mod itself, things I would do different (again, don't know if better):
1. Increase DW by 5% from the start.
2. Increase TL less for 1750-2750 rpm and a small bit more at the top range. (20% in nm gives a bit more % in IQ)
3. Decrease the maf tables a bit more from lower maf readings (they are low already).
4. Change the SOI by a degree on the whole table and 2-3 degrees after rescaling for the new IQ. (This is a sensitive topic, many opinions here). Leaving it stock is a good idea for a safe remap
5. Wouldn't increase requested turbo pressure so much at low rpm - it may spike because of that from my experience.
6. EGR - another thing of debate. I would turn it off just because it gives too much trouble by clogging the intake system. Maybe the tuner wanted extra money for that or believe the repair when broken approach

Things that seem wrong:
1. Locked out on some IQ limiters. Some IQ limiter are lower than the main TL, can't find a logical explanation for this one.
2. Boost increase at lower IQ and no rescaling. From my experience lowering boost at lower IQ ,increase economy.

As for rail pressure - I doubt that he did now know the SVFP limiters. I sometimes increase the rail pressure by percentage

and leave it a bit higher than the limiter. The requested fuel pressure will be set at the SVFP value. Maximum rail pressure increase is a sensitive thing and usually gives trouble by overshooting or undershooting. I touch it only on the cars that I have or I know it works flawlessly. I remember tuning a 1.9 JTD Alfa, touched the SVFP limiters, and after giving full load car went into limp mode with a dtc of overshooting the fuel pressure. I believe the regulator control map needs adjusting, but it is a lot easier to leave it stock than to play and get it 100% right. You could develop a 100% perfect tune on a dyno, doing a lot of tests and runs, but the car would become golden then

As for DW at 5000 rpm - it makes no difference at all, because TL is lower.

Overall the file is not bad and not perfect in my opinion (which is usually wrong)

Conclusion:
Thanks to everybody!