ProECU Subaru DIT

Tuning Guide

2012-onward Model Year

v1.29

Contents

1. Warning

!!! CAUTION !!!

EcuTek ProECU tuning tools should only be used by experienced tuners who understand the product and engine calibration.

If you do not fully understand this product then you WILL damage your engine, the ECU or your vehicle.

Please ensure you fully read all EcuTek manuals BEFORE attempting to use ProECU with your laptop or your vehicle.

Use with extreme caution and understanding at all times, if in doubt then do not proceed.

EcuTek accepts no responsibility for any damage to the engine, ECU or any part of the vehicle that results directly or indirectly from using the product.

** If you are in any doubt that you do NOT have the experience required to use this product then you should NOT USE IT **

2. Introduction

2.1. ProECU – DIT

EcuTek are proud to offer ProECU tuning suite for the new Subaru DIT engine. This FA20 DIT variant is based on the current Subaru BRZ, Scion FR-S and Toyota GT86 engine, but unlike the BRZ/FA20 engine that used a Toyota based Port and Direct injection system, the new DIT uses Subaru's own DI system, developed by Hitachi. This new DI system is also found on the Nissan Juke 1.6 DiG Turbo model that ProECU already supports.

The 2.0ltr DIT engine is found in the following models:

Legacy GT – 300bhp (Japan only)

Forester XT – 240bhp (Euro, Australia and USA)

WRX – 260bhp (Australia, USA, Russia and Asia)

The new 1.6ltr model Levorg will also be supported in the near future.

All of the above are CVT transmission models apart from the WRX which is available with a manual gearbox option.

The ProECU DIT tuning suite supports all models from all regions with high speed programming and high speed datalogging and includes the typical ProECU features available in other tuning suites. ProECU also includes an ECU Recovery feature in the event of a programming failure.

2.2. RaceROM - DIT

RaceROM offers special custom written features for the Subaru DIT platform. These are only available from EcuTek using ProECU.

RaceROM Features currently available for Subaru DIT are:

- RaceROM Boost Controller
- 3 Way Map Switching
- Speed Density
- Custom Maps*
- Launch Control including Boost Off The Line (BOTL)
- Custom Gauge Display - Accel and Oil Temp Display Hijack
- Rear O2 Sensor Importing
- Ethanol Flex-Fuel Tuning
- 30+ Custom Data Logging Parameters
- ECU Data Security

* See Custom Maps manual for specific feature information

3. ECU Map Descriptions

Please note that map names are shown in **bold**. Live Data parameters can be used for Data Logging and are shown in *italic*.

3.1. Fuelling

Live Data related parameters:

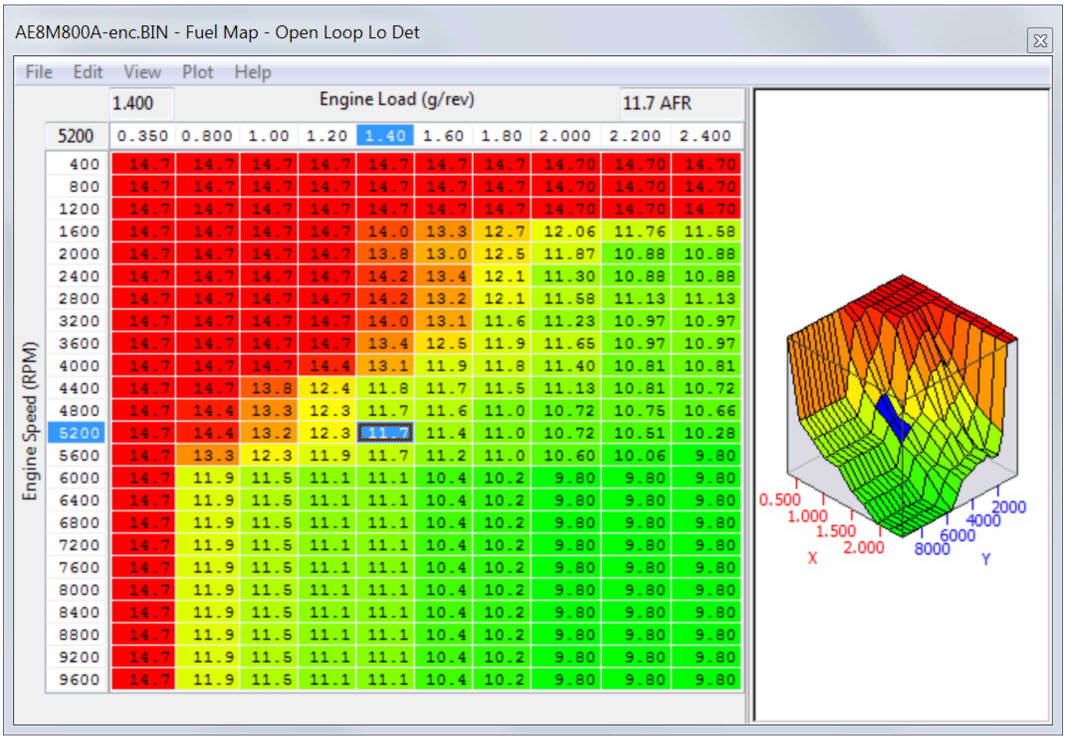
- *A/F Target*
- *A/F Sensor*
- *Fuel Trim Long Term*
- *Fuel Trim Short Term*
- *Engine Load (g/rev requires RaceROM)*
- *Mass Air Flow*

The fuel maps contain a target AFR based on Engine Speed (RPM) and Engine Load (grams/rev). The X and Y axis scaling can be adjusted to suit higher RPMs or higher Engine Loads if required. The fuel maps are either **Open Loop** or **Closed Loop** and they are defined below.

3.1.1. Fuel Maps – Open Loop

Fuel Map - Open Loop Hi Det – This map is used when the engine is knocking hard and continuously and a richer AFR is required to reduce knock and reduce cylinder temps.

Fuel Map - Open Loop Lo Det – This map is used under normal running and the AFR values chosen are used in an open Loop control condition.



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400	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
800	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
1200	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
1600	14.7	14.7	14.7	14.7	14.0	13.3	12.7	12.06	11.76	11.58
2000	14.7	14.7	14.7	14.7	13.8	13.0	12.5	11.87	10.88	10.88
2400	14.7	14.7	14.7	14.7	14.2	13.4	12.1	11.30	10.88	10.88
2800	14.7	14.7	14.7	14.7	14.2	13.2	12.1	11.58	11.13	11.13
3200	14.7	14.7	14.7	14.7	14.0	13.1	11.6	11.23	10.97	10.97
3600	14.7	14.7	14.7	14.7	13.4	12.5	11.9	11.65	10.97	10.97
4000	14.7	14.7	14.7	14.4	13.1	11.9	11.8	11.40	10.81	10.81
4400	14.7	14.7	13.8	12.4	11.8	11.7	11.5	11.13	10.81	10.72
4800	14.7	14.4	13.3	12.3	11.7	11.6	11.0	10.72	10.75	10.66
5200	14.7	14.4	13.2	12.3	11.7	11.4	11.0	10.72	10.51	10.28
5600	14.7	13.3	12.3	11.9	11.7	11.2	11.0	10.60	10.06	9.80
6000	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
6400	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
6800	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
7200	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
7600	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
8000	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
8400	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
8800	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
9200	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80
9600	14.7	11.9	11.5	11.1	11.1	10.4	10.2	9.80	9.80	9.80

Fuel Map – Open Loop Compensation* – This AFR Enrichment factor is added depending on the current AM (Advance Multiplier). The weighting factor of how it's applied for a certain AM can be calibrated in the following map.
The compensation map is profiled so when the AM reduces (engine knocking) then the AFR will become richer in the areas where the engine is most susceptible to detonation (like at peak torque).

Fuel Map – Open Loop Compensation Multiplier* – This is the percentage ratio of the **Fuel Map – Open Loop Compensation** that is added to the **Fuel Map – Open Loop Lo Det** for a given AM.

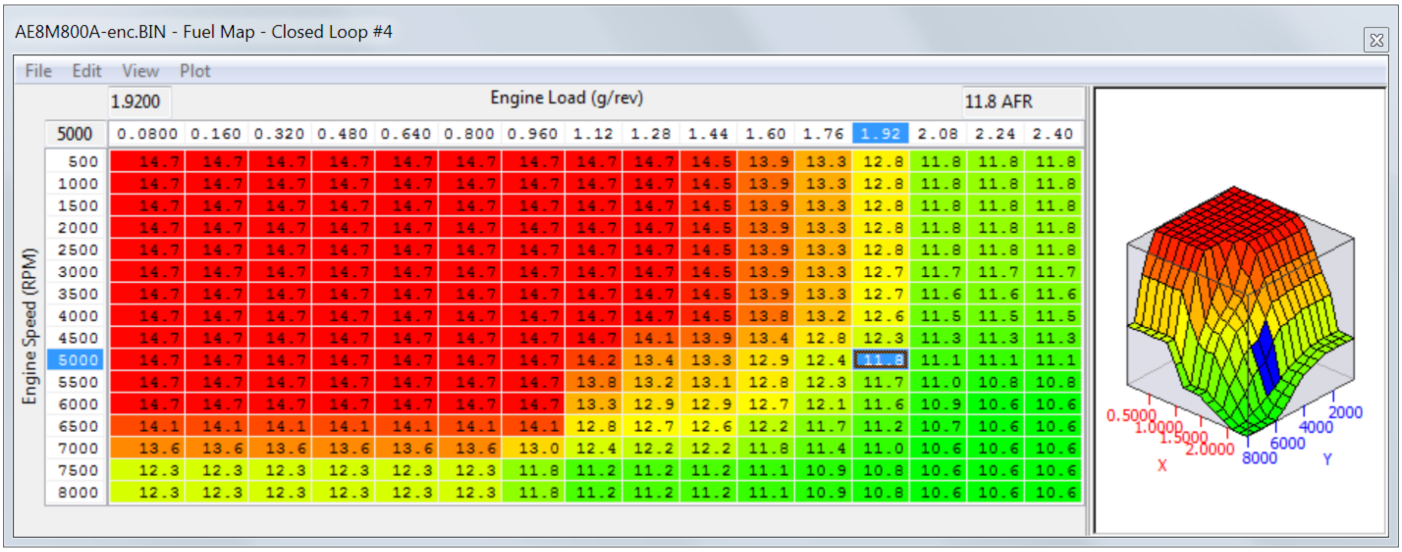
If this map doesn't exist in a particular ROM, the ECU works in the following way:
- when the AM is 0.0, 100% of the map value is added
- when the AM is 1.0, 0% of the map value is added

intermediate AM values will add a partial enrichment, for example:
- when the AM is 0.7, 30% of the map value is added

* This map is not found in all ROMs

3.1.2. Fuel Maps – Closed Loop

Fuel Map – Closed loop #1 - #5 – These maps are used when the engine is in Closed Loop and the Fuel Trim Short Term (FTST) correction is active.
These maps are used at light load and also on full load and it should be noted that the Closed Loop value does not have to be 14.7:1 AFR.
If the Closed Loop target AFR value is 13.5:1 or even 12:1 AFR then the ECU will maintain Closed Loop control using the FTST.
There are up to #5 Closed Loop target maps (depending on the exact ROM version) but the exact condition that the ECU switches between the maps is currently unknown.
Fuel Map – Closed Loop #4 is used most of the time but the ECU seems to step and interpolate between these maps so use with caution and understanding.



5000	0.0800	0.160	0.320	0.480	0.640	0.800	0.960	1.12	1.28	1.44	1.60	1.76	1.92	2.08	2.24	2.40
500	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.5	13.9	13.3	12.8	11.8	11.8	11.8
1000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.5	13.9	13.3	12.8	11.8	11.8	11.8
1500	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.5	13.9	13.3	12.8	11.8	11.8	11.8
2000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.5	13.9	13.3	12.8	11.8	11.8	11.8
2500	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.5	13.9	13.3	12.8	11.8	11.8	11.8
3000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.5	13.9	13.3	12.7	11.7	11.7	11.7
3500	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.5	13.9	13.3	12.7	11.6	11.6	11.6
4000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.5	13.8	13.2	12.6	11.5	11.5	11.5
4500	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.1	13.9	13.4	12.8	12.3	11.3	11.3	11.3
5000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.2	13.4	13.3	12.9	12.4	11.8	11.1	11.1	11.1
5500	14.7	14.7	14.7	14.7	14.7	14.7	14.7	13.8	13.2	13.1	12.8	12.3	11.7	11.0	10.8	10.8
6000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	13.3	12.9	12.9	12.7	12.1	11.6	10.9	10.6	10.6
6500	14.1	14.1	14.1	14.1	14.1	14.1	14.1	12.8	12.7	12.6	12.2	11.7	11.2	10.7	10.6	10.6
7000	13.6	13.6	13.6	13.6	13.6	13.6	13.0	12.4	12.2	12.2	11.8	11.4	11.0	10.6	10.6	10.6
7500	12.3	12.3	12.3	12.3	12.3	12.3	11.8	11.2	11.2	11.2	11.1	10.9	10.8	10.6	10.6	10.6
8000	12.3	12.3	12.3	12.3	12.3	12.3	11.8	11.2	11.2	11.2	11.1	10.9	10.8	10.6	10.6	10.6

Fuel Map – Closed Loop Compensation ** **–** This AFR Enrichment factor is added depending on the current AM (Advance Multiplier). The weighting factor of how it's applied for a certain AM can be calibrated in the following map.
The compensation map is profiled so when the AM reduces (engine knocking) then the AFR will become richer in the areas where the engine is most susceptible to detonation (like at peak torque).

Fuel Map – Closed Loop Compensation Multiplier ** **–** This is the percentage ratio of the **Fuel Map – Closed Loop Compensation** that is added to the **Fuel Map – Closed Loop** for a given AM.

If this map doesn't exist in a particular ROM, the ECU works in the following way:
- when the AM is 0.0, 100% of the map value is added
- when the AM is 1.0, 0% of the map value is added
intermediate AM values will add a partial enrichment, for example:
- when the AM is 0.7, 30% of the map value is added

Closed Loop – Minimum AFR – This Minimum AFR value for Closed Loop. If the desired value in the Closed Loop fuel map is below this value, the ECM will switch to Open Loop and use the Open Loop fuel map instead.

Fuel Map – Quick Torque Demand – This Closed Loop target AFR map is selected when the Accel pedal is depressed very quickly (where the driver is demanding a sudden and immediate increase in engine torque and acceleration). This map is used in a Closed Loop condition.
The ECU is entering a special 'Hi Torque' mode and this condition is also reflected in the VVT maps that are chosen. The map is used in closed loop regardless of the AFR target values in the 'Fuel Map - Open Loop'. The ECU will stay in the mode until the Accel pedal is released and the normal engine control strategy is resumed.

** This map is not found in all ROMs

3.1.3. Open - Closed Loop Control

The **Fuel Map – Open Loop Lo Det** and **Fuel Map – Open Loop Hi Det** are the main tables that set the Target AFR and also determine if Closed or Open loop fuelling will be used:

- A 14.7 value in the **Fuel Map Lo Det** indicates that the ECU should work in a Closed Loop mode condition and the Target AFR value is selected from one of the maps called **Fuel Map – Closed Loop #1 - #5** (FTST is working).
- A value lower than 14.7 **Fuel Map – Open Loop Lo Det** indicates that the ECU should work in Open Loop mode condition the target AFR value comes from the **Fuel Map – Open Loop Lo Det** map itself (FTST is NOT working).

When the ECU switches from a Closed Loop condition to an Open Loop then there are timers and transitional ramp rates that must be considered and appreciated.

**** IMPORTANT ****

The ECU will target 14.7:1 AFR when switching from Closed to Open Loop mode, it will ignore any richer Target AFR values in the Closed or Open Loop fuel maps.

Open Loop – Stoich to Target delay – The time period required to decay when the ECU will switch from Closed to Open Loop. This map should always be filled with 0 so there is no time delay when transitioning from a Closed Loop to an Open Loop condition.

Open Loop – Stoich to Target transition rate – This map should be filled with the maximum allowed value of 1000 so the step amount during Closed to Open Loop is as fast as possible and there is no delay in the transition between the two modes. Setting this map to zero would mean the transition from Closed to Open Loop would take a very long time and remember the AFR during transition is leaner than 14:1 AFR!!!

Open Loop – Maximum AFR – The Maximum AFR value for Open Loop.
If the desired value in the Open Loop fuel map is higher than this value, the ECM will use this target value instead.

Closed Loop – Minimum AFR – The Minimum AFR value for Closed Loop.
If the desired value in the Closed Loop fuel maps is below this value, the ECM will switch to Open Loop and use the Open Loop fuel map instead. This may be set to zero in some region ROMs so this strategy is not used.

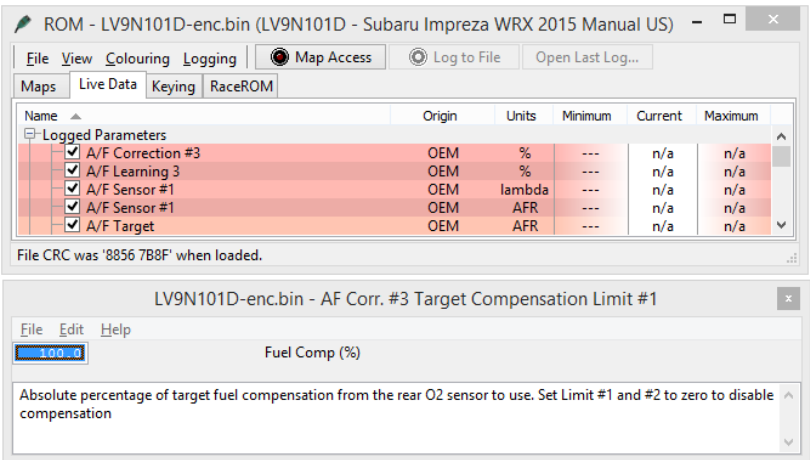
Other important notes:
If the ECU is in Closed Loop mode, then the *Short Term Fuel Trim* will be active.
If the ECU is in Open Loop mode, then the *Short Term Fuel Trim* will not be active and FTST will show the Live Data logging parameter as zero.

The AFR values shown in the Open Loop fuel maps will be achieved in open loop mode on a stock vehicle as these values are based on a stock intake and an accurately measured amount of airflow, so the correct amount of fuel volume will be injected to deliver the AFR in the Open Loop map.

If the Intake has been replaced then the MAF scaling should be adjusted until the AFR value in the Open Loop map is roughly the same for a given RPM and Engine Load. Ensure that your actual engine load parameter shown in the data logging does not exceed the Engine Load Values shown in the X axis of the fuel map. If it does, then rescale your maps for the higher engine load that is achieved.

3.1.4. Fuel Trims

The ECU may use Fuel Trim Long Term in open loop, this can causes serious problems for the full load AFR over a period of time. The rear o2 sensor fuel trims are called AF Correction #3 by Subaru and they should be disabled in open loop, simply set the values to zero as shown below (WRX only). Legacy and Forester use the map called ‘Closed Loop – Rear O2 sensor compensation’ this should be unchecked if the Rear O2 is used for other purposes on these models.



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3.1.5. Warm-Up Enrichment

These maps provide an enrichment factory during warm up (after starting), if a greater volume of fuel is required during this post start period and before closed loop fuel control kicks in then these maps can be adjusted. Its subjected that all enrichment maps should be adjusted by a percentage.

3.1.6. Injection Control

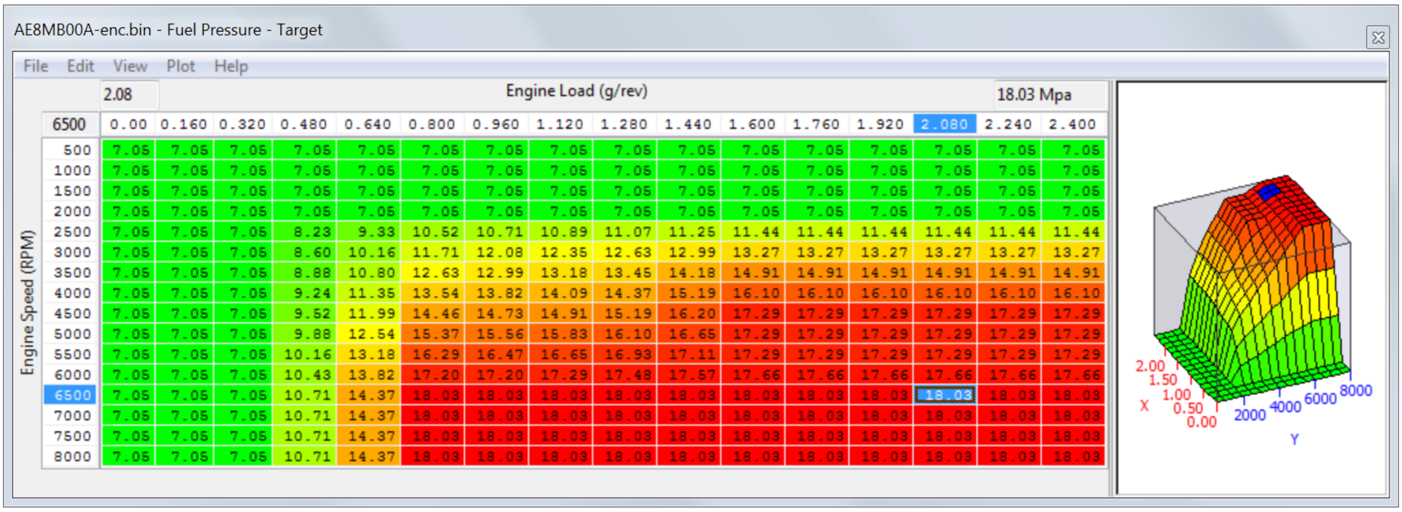
Live Data related parameters:

- *Fuel Injection Pulse Width*
- *Fuel Pressure - Target*
- *Fuel Pressure - Gauge*
- *Fuel Pump Duty*
- *Fuel Injection End to Spark*
- *Fuel Injection Angle*

Fuel Pressure - Target

This is the target pressure for the fuel rail, this is a mechanical pump and it has limitations for what it can deliver.

The units are MPa and 18MPa is 180bar so take care when working with the DI system.
Our testing has shown that the stock fuel pump can only supply enough fuel for around 340 to 350bhp (depending on AFR). Beyond this a high pressure high flow fuel pump will need to be fitted. Demanding a higher pressure will not automatically mean the mechanical pump can deliver it.



6500	0.00	0.160	0.320	0.480	0.640	0.800	0.960	1.120	1.280	1.440	1.600	1.760	1.920	2.080	2.240	2.400
500	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05
1000	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05
1500	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05
2000	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05	7.05
2500	7.05	7.05	7.05	8.23	9.33	10.52	10.71	10.89	11.07	11.25	11.44	11.44	11.44	11.44	11.44	11.44
3000	7.05	7.05	7.05	8.60	10.16	11.71	12.08	12.35	12.63	12.99	13.27	13.27	13.27	13.27	13.27	13.27
3500	7.05	7.05	7.05	8.88	10.80	12.63	12.99	13.18	13.45	14.18	14.91	14.91	14.91	14.91	14.91	14.91
4000	7.05	7.05	7.05	9.24	11.35	13.54	13.82	14.09	14.37	15.19	16.10	16.10	16.10	16.10	16.10	16.10
4500	7.05	7.05	7.05	9.52	11.99	14.46	14.73	14.91	15.19	16.20	17.29	17.29	17.29	17.29	17.29	17.29
5000	7.05	7.05	7.05	9.88	12.54	15.37	15.56	15.83	16.10	16.65	17.29	17.29	17.29	17.29	17.29	17.29
5500	7.05	7.05	7.05	10.16	13.18	16.29	16.47	16.65	16.93	17.11	17.29	17.29	17.29	17.29	17.29	17.29
6000	7.05	7.05	7.05	10.43	13.82	17.20	17.20	17.29	17.48	17.57	17.66	17.66	17.66	17.66	17.66	17.66
6500	7.05	7.05	7.05	10.71	14.37	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03
7000	7.05	7.05	7.05	10.71	14.37	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03
7500	7.05	7.05	7.05	10.71	14.37	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03
8000	7.05	7.05	7.05	10.71	14.37	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03	18.03

Fuel Pressure - Maximum

This is the maximum allowed fuel pressure target in MPa, these values can be increased slightly to deliver more fuel but ultimately the high pressure fuel pump is serious limited by the additional fuel volume that it can deliver per pump revolution.

Fuel Pump Duty

The fuel pressure duty cycles set for the primary lift pump – No need to alter these settings unless a larger high pressure and low pressure pump has been fitted.

Direct Injector Open Time – Fuel Pressure

This is the Direct Injector (DI) open time period for a given fuel pressure. Increasing these values by a set percentage (%) will directly open the DI for a longer period.
This map can be used as the DI multiplier for Ethanol tuning.

Fuel Injection Angle

This is the crankshaft angle before TDC that Direct Injection will open and start to inject fuel (Start Of Injection - SOI). See the Tuning section for more information.

Engine Load Compensation #1 - #2

These 3d maps are used a part of a volumetric efficiency calculation to correct the engine load in certain condition, its particular noticeable in map #1 when TGV is closed and there is a lot of valve overlap at light load when compared to light load high RPM.
Increasing or decreasing the map values will directly affect Engine Load, Ignition Timing and Injector open time but it does not affect the Mass airflow (as shown in the mass airflow logging parameter). See the tuning section for more information

3.2. Ignition Timing

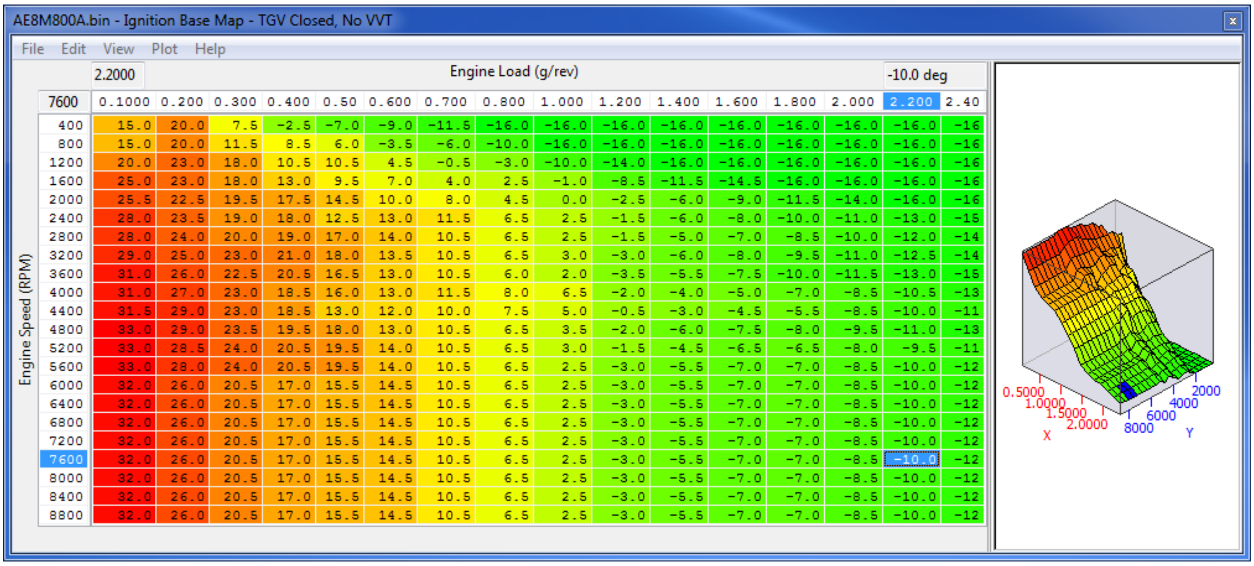
Live Data related parameters:

- *Advance Multiplier – The percentage of the Ignition Advance map that's added to the base ignition map*
- *Ignition Timing – The actual Ignition Timing*
- *Ignition Timing – Learned (AT) – The output of the Ignition Advance map * Advance Multiplier*
- *Knocking Correct (Retard Amount AK) – The immediate amount of knock retard or positive correction*
- *Knocking Signal - Knocking On or Off*
- *Learned Ignition Timing - The output of the Ignition Advance map * Advance Multiplier*
- *Learnt Ignition Timing Correction – The Advance Multiplier shown as a value of 0 to 15*

3.2.1. Ignition Base Map

The ECU selects an **Ignition Base Map** depending on the current VVT and TGV status:

- TGV Closed, VVT Off
- TGV Closed, VVT On
- TGV Open, VVT Off
- TGV Open, VVT On

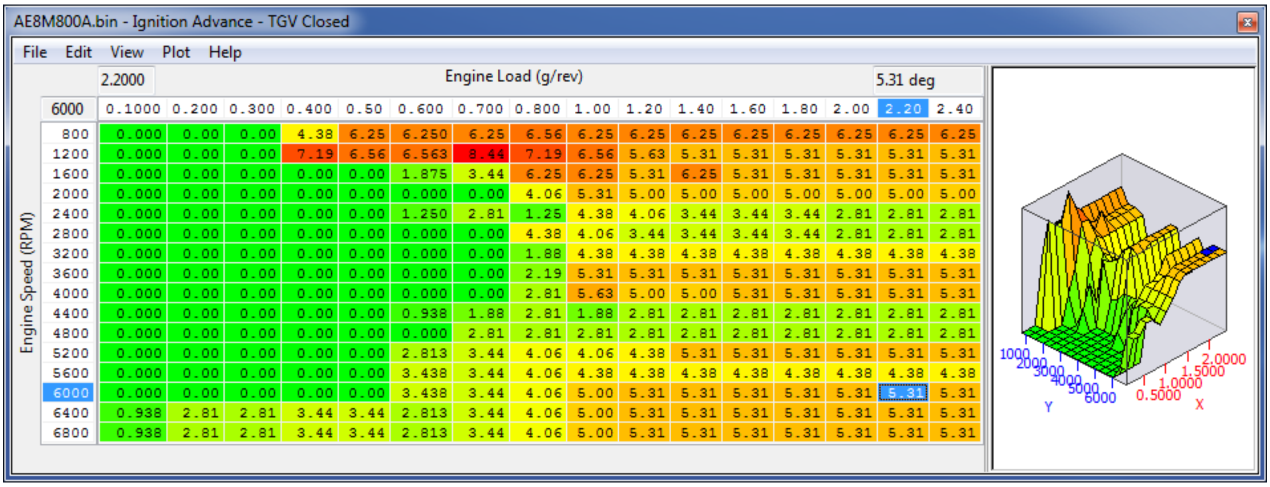


7600	0.1000	0.200	0.300	0.400	0.50	0.600	0.700	0.800	1.000	1.200	1.400	1.600	1.800	2.000	2.200	2.40
400	15.0	20.0	7.5	-2.5	-7.0	-9.0	-11.5	-16.0	-16.0	-16.0	-16.0	-16.0	-16.0	-16.0	-16.0	-16
800	15.0	20.0	11.5	8.5	6.0	-3.5	-6.0	-10.0	-16.0	-16.0	-16.0	-16.0	-16.0	-16.0	-16.0	-16
1200	20.0	23.0	18.0	10.5	10.5	4.5	-0.5	-3.0	-10.0	-14.0	-16.0	-16.0	-16.0	-16.0	-16.0	-16
1600	25.0	23.0	18.0	13.0	9.5	7.0	4.0	2.5	-1.0	-8.5	-11.5	-14.5	-16.0	-16.0	-16.0	-16
2000	25.5	22.5	19.5	17.5	14.5	10.0	8.0	4.5	0.0	-2.5	-6.0	-9.0	-11.5	-14.0	-16.0	-16
2400	28.0	23.5	19.0	18.0	12.5	13.0	11.5	6.5	2.5	-1.5	-6.0	-8.0	-10.0	-11.0	-13.0	-15
2800	28.0	24.0	20.0	19.0	17.0	14.0	10.5	6.5	2.5	-1.5	-5.0	-7.0	-8.5	-10.0	-12.0	-14
3200	29.0	25.0	23.0	21.0	18.0	13.5	10.5	6.5	3.0	-3.0	-6.0	-8.0	-9.5	-11.0	-12.5	-14
3600	31.0	26.0	22.5	20.5	16.5	13.0	10.5	6.0	2.0	-3.5	-5.5	-7.5	-10.0	-11.5	-13.0	-15
4000	31.0	27.0	23.0	18.5	16.0	13.0	11.5	8.0	6.5	-2.0	-4.0	-5.0	-7.0	-8.5	-10.5	-13
4400	31.5	29.0	23.0	18.5	13.0	12.0	10.0	7.5	5.0	-0.5	-3.0	-4.5	-5.5	-8.5	-10.0	-11
4800	33.0	29.0	23.5	19.5	18.0	13.0	10.5	6.5	3.5	-2.0	-6.0	-7.5	-8.0	-9.5	-11.0	-13
5200	33.0	28.5	24.0	20.5	19.5	14.0	10.5	6.5	3.0	-1.5	-4.5	-6.5	-6.5	-8.0	-9.5	-11
5600	33.0	28.0	24.0	20.5	19.5	14.0	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12
6000	32.0	26.0	20.5	17.0	15.5	14.5	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12
6400	32.0	26.0	20.5	17.0	15.5	14.5	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12
6800	32.0	26.0	20.5	17.0	15.5	14.5	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12
7200	32.0	26.0	20.5	17.0	15.5	14.5	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12
7600	32.0	26.0	20.5	17.0	15.5	14.5	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12
8000	32.0	26.0	20.5	17.0	15.5	14.5	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12
8400	32.0	26.0	20.5	17.0	15.5	14.5	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12
8800	32.0	26.0	20.5	17.0	15.5	14.5	10.5	6.5	2.5	-3.0	-5.5	-7.0	-7.0	-8.5	-10.0	-12

3.2.2. Ignition Advance

The **Ignition Advance map** is added to the **Ignition Base map** relative to the LIVE DATA parameter called *Advance Multiplier* (AM). The **Ignition Advance map** is used as a coarse Ignition adjustment to advance and retard the Ignition timing for changing conditions like fuel quality, ambient temperature and altitude. On some models the **Ignition Advance** maps may be added together then added to the **Ignition Base** map so take care when adjusting these maps and watch carefully to understand the control.

The factory **Ignition Advance map** is calibrated to advance and retard the ignition timing by a greater degree in certain areas of the map (as seen in the next screen shot).
This is to ensure when the engine is knocking (and the AM decreases) that more Ignition timing is removed from areas where the engine is more susceptible to detonation (like peak torque).
Areas where the engine is least likely to detonate the values are smaller (like light load).



6000	0.1000	0.200	0.300	0.400	0.50	0.600	0.700	0.800	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40
800	0.000	0.00	0.00	4.38	6.25	6.250	6.25	6.56	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
1200	0.000	0.00	0.00	7.19	6.56	6.563	8.44	7.19	6.56	5.63	5.31	5.31	5.31	5.31	5.31	5.31
1600	0.000	0.00	0.00	0.00	0.00	1.875	3.44	6.25	6.25	5.31	6.25	5.31	5.31	5.31	5.31	5.31
2000	0.000	0.00	0.00	0.00	0.00	0.000	0.00	4.06	5.31	5.00	5.00	5.00	5.00	5.00	5.00	5.00
2400	0.000	0.00	0.00	0.00	0.00	1.250	2.81	1.25	4.38	4.06	3.44	3.44	3.44	2.81	2.81	2.81
2800	0.000	0.00	0.00	0.00	0.00	0.000	0.00	4.38	4.06	3.44	3.44	3.44	3.44	2.81	2.81	2.81
3200	0.000	0.00	0.00	0.00	0.00	0.000	0.00	1.88	4.38	4.38	4.38	4.38	4.38	4.38	4.38	4.38
3600	0.000	0.00	0.00	0.00	0.00	0.000	0.00	2.19	5.31	5.31	5.31	5.31	5.31	5.31	5.31	5.31
4000	0.000	0.00	0.00	0.00	0.00	0.000	0.00	2.81	5.63	5.00	5.00	5.31	5.31	5.31	5.31	5.31
4400	0.000	0.00	0.00	0.00	0.00	0.938	1.88	2.81	1.88	2.81	2.81	2.81	2.81	2.81	2.81	2.81
4800	0.000	0.00	0.00	0.00	0.00	0.000	2.81	2.81	2.81	2.81	2.81	2.81	2.81	2.81	2.81	2.81
5200	0.000	0.00	0.00	0.00	0.00	2.813	3.44	4.06	4.06	4.38	5.31	5.31	5.31	5.31	5.31	5.31
5600	0.000	0.00	0.00	0.00	0.00	3.438	3.44	4.06	4.38	4.38	4.38	4.38	4.38	4.38	4.38	4.38
6000	0.000	0.00	0.00	0.00	0.00	3.438	3.44	4.06	5.00	5.31	5.31	5.31	5.31	5.31	5.31	5.31
6400	0.938	2.81	2.81	3.44	3.44	2.813	3.44	4.06	5.00	5.31	5.31	5.31	5.31	5.31	5.31	5.31
6800	0.938	2.81	2.81	3.44	3.44	2.813	3.44	4.06	5.00	5.31	5.31	5.31	5.31	5.31	5.31	5.31

The X and Y axis scaling can be adjusted to suit higher RPM or higher Engine Loads if required.

The output of the **Ignition Advance map** is important and can be seen and logged in LIVE DATA as *Ignition Timing Learned* parameter.
So 'for explanation purpose only', if the **Ignition Advance map** was filled with 12 deg then the *Ignition Timing Learned* value would read 12 deg in LIVE DATA (assuming the AM is 1).
If the AM is 0.75 then the *Knock Correction Learn Value* would read 9 deg (12 * 0.75 = 9 deg).
If the AM is 1 but the *Ignition Timing Learned* value is less than 12 deg at some points during a power run this indicates historical knocking events that have been *Learned* (see below for further information).

NOTE: In "Mode 1", the ECU will use the original Base Ignition Timing and Ignition Advance map strategy labelled as TGV and VVT ON/OFF.
In mode 2 and 3, the ECU will use the new singular RaceROM Ignition Timing and Ignition Advance maps labelled Mode2 and Mode3 respectively. So the factory multiple Ignition control for different VVT/TGV conditions is not used in Mode 2 and Mode 3.
Any Ignition Timing Compensations for Air Temp or transient will still be included in the Ignition Timing compensation.

3.2.3. Advance Multiplier - Coarse Correction

The *Advance Multiplier* (AM) is dynamic and will change relative to the current amount of engine knocking (detonation). If the engine is knocking frequently and consistently then the AM will be low, if there is no knocking then the AM will be high. The AM moves between 0 and 1. The highest advance multiplier number obtainable is 1.

If the AM is 0 then NONE of the **Ignition Advance map** will be added to the **Ignition Base map**.
If the AM is 1 then ALL of the **Ignition Advance map** will be added to the **Ignition Base map**.
If the AM is 0.73 then 73% of the current **Ignition Advance map** value will be added to the **Ignition Base map.**

3.2.4. Advance Multiplier - Initial

This is the base default setting for the advance multiplier after ECU Programming or ECU Reset. This can be increased to 1 for tuning purpose so that 100% of the **Ignition Advance map** is added to the **Ignition Base map**. It is advised to reset back to its default value on the final flash of the ECU.

3.2.5. Intake Air Temp Compensations

The 2d map called “Ignition Timing – IAT Compensation” will retarded the Ignition Timing at high intake air temps, especially over 40deg C. The amount of retard applied is controlled by the 3d map called “Ignition Timing – IAT Compensation Multiplier”.
This multiplier map shows that very little retard will be applied at lower load regions but the majority of retard will be applied on full load (where the engine will be most susceptible to detonation)

3.2.6. Ignition Retard #1 - #5

This is per gear Ignition retard amount applied to the current Ignition Timing.
The maps are difficult to document on CVT models due to the complexity of the CVT control.
The Ignition Retard map chosen depends on vehicle speed and engine rpm.
The current Ignition Retard map selected can also change depending on the current SI Drive mode selected (as additional gears can be added depending on the mode).
You should test your results to be sure of the exact control on your particular vehicle.

Below are some finding on our Legacy DIT:

Retard maps #1- #4 are used in their respective gears 1-4 in ALL of the SI drive modes.
Map #5 is used in both S and I mode for 5^{th} gear but not in 6^{th} gear.
Map #5 is used in 5^{th} and 6^{th} gear in Sport # mode.
None of these maps appear to function in the highest gear ratio 7^{th} gear.
Remember that the current gear judgement is altered by SI Drive selection (as Sport # offers an additional 7^{th} or 8^{th} gear)

Ignition Timing calculation
The final Ignition Timing calculation is computed like this:

*Ignition Base Map + (Ignition Advance Map * Advance Multiplier) + Ignition Compensations + Ignition Fine Learning + Knock Correction*

It’s a very active and dynamic control strategy that will constantly adjust the ignition timing but it should not be fully trusted to ‘control the ignition’. The final Ignition Timing logging parameter will include any compensations or corrections that have been made by the above maps.

3.2.7. Knock Correction

If the engine knocks then the ECU will immediately remove an amount of ignition timing (Knock Retard amount) and this will be shown in LIVE DATA as the *Knock Correction (Retard Amount AK)* parameter. The logging parameter called *Knocking Signal* will show when the engine is knocking (0 or 1).
After a *Knock* event has occurred and an amount of Ignition timing has been removed from the current Ignition Timing calculation then the ECU will store 50% of that *knock correction* event to pre-empt a similar knock event at the same RPM and same Load the next time round.
This is the long term 'Ignition Fine Learning' strategy.

3.2.8. Ignition Knock Retard

When the Advance Multiplier is less than 1 then the ECU will adopt a fine learning control to constantly correct and optimise the Ignition Timing to the point of knock. When no knock is present the ECU will raise the Advance Multiplier.
This Ignition fine learning feedback control is shown in Live Data as the logging parameter called *Knock Correction (Retard Amount AK)*, this control can advance and retard the timing.
The maximum amount of advance or retard and the ignition timing step amount used can be adjusted in the Fine Learning maps below.

Knock Retard Maximum

This is the maximum amount of knock regard (AK) the ECU is allowed to remove. The default value is 12 deg, you should not need to increase this value.

Knock Retard Decrement – Gamma F

This is the magnitude of successive knock retard operations. So the amount of timing removed each time knock is detected, making these values bigger will make the knock retard (AK) amount greater for a given knock event.

Knock Retard Increment – Alpha F

This is the step amount value for reducing the knock retard amount after the knocking has stopped. Making these values bigger will mean the knock retard amount will be phased out more quickly after the knocking event has finished.

Knock Retard Increment Delay Period

The time period required to expire when the knock event has finished and the Knock Correction AK can start to be reduced.

3.2.9. Knock Sensitivity

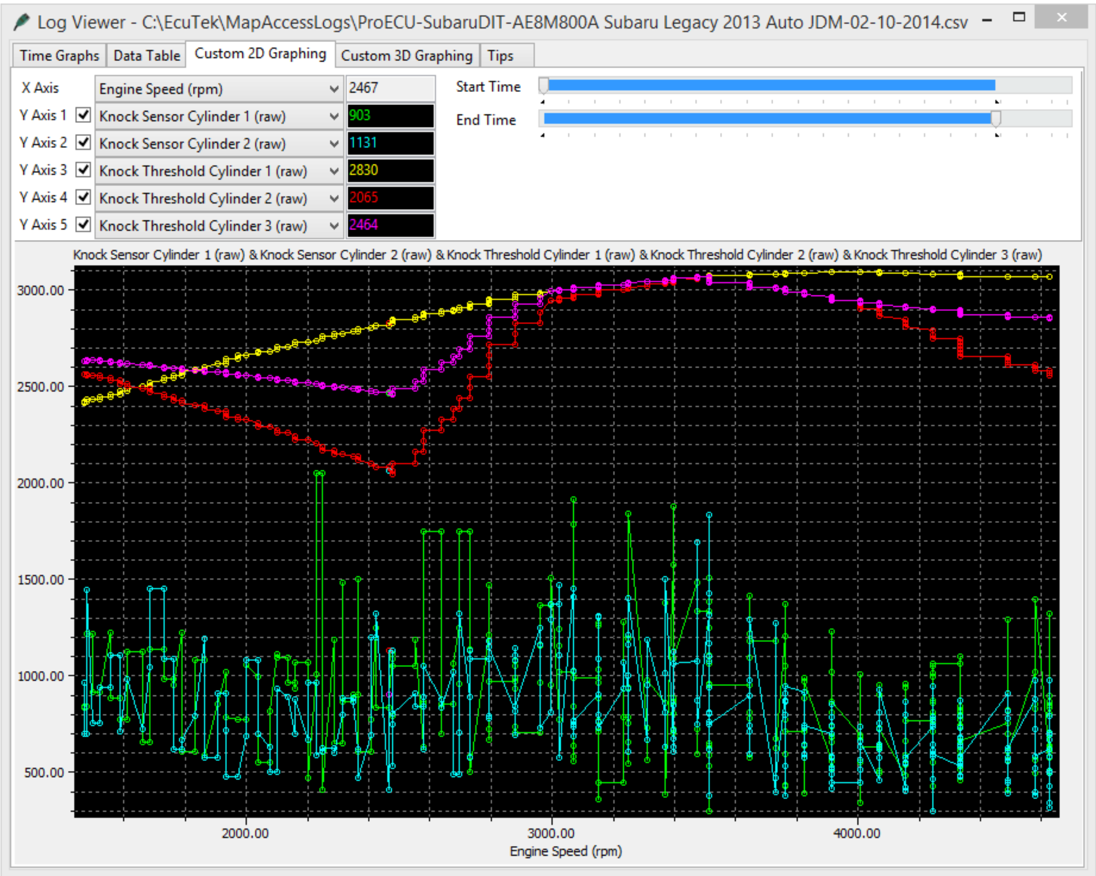
The Knock Sensitivity Per Cylinder maps show the knock sensor threshold where knock correction will become active for each cylinder. If the threshold is breached (for a given RPM and Load) then the knock correction parameter will start to show knock retard and will therefore be retarding the Ignition Timing to reduce cylinder pressure and avoid subsequent knock events.

Increasing these values will result in reduced Knock Correction amount (less retard) for a given knock sensor noise level, so an overall reduction in knock sensitivity. This will allow more Ignition Advance before knock is detected though extreme care must be taken to ensure true knock is still detected!

Reducing these values will result in an increased Knock Correction amount (more retard) for a given knock sensor noise level, so an overall increase in knock sensitivity. This will allow less Ignition Advance before knock is detected.

You will see from the log file below that some cylinders have different thresholds to others and that Cylinder 2 has a low threshold compared to Cylinders 1 or 3.

***NOTE**: the logging rate cannot capture all knock events so use with caution and understanding!*



3.2.10. Ignition Fine Learning Control

When the Advance Multiplier is less than 1 then the ECU will adopt a fine learning control to constantly correct and optimise the Ignition Timing to the point of knock. When no knock is present the ECU will raise the Advance Multiplier.
This Ignition fine learning feedback control is shown in Live Data as the logging parameter called *Knock Correction (Retard Amount AK)*, this control can advance and retard the timing.
The maximum amount of advance or retard and the ignition timing step amount used can be adjusted in the Fine Learning maps below.

If *Knocking Correction* shows a -4 deg has been removed from the current Ignition timing calculation then 50% of this *Knock Correction* amount (-2 deg) will be stored in memory for a given RPM and Engine Load range for next time. If a negative value is already stored for that RPM and Load then the value is simply added to stored 'Fine Learning value'
If -1 deg was already stored in memory for a given RPM and Load then a further -2deg would also be added making a total of -3 deg stored for the same RPM/Load memory location.
The next time the engine passes the same RPM and Engine Load then the Fine Learning value (-3 deg) would be recalled and subtracted from the Ignition Timing calculation at that point. This is the principle of the Fine Learning control that is used to adjust the Advance Multiplier.

When the learned value is 50% or greater than the corresponding values in the **Ignition Advance map** then the AM will be decreased and all Fine Learning stored values are cleared and the process starts all over again. In the event that no further knocking is experienced then the ECU will add positive Fine Learning values in +0.35 deg increments to build out the learned negative values. When all negative values have been built out and the positive values are 50% or greater than the values in the **Ignition Advance map** then the AM will increase and therefore advance the whole ignition curve.

Fine Ign Learning Max Advance

The maximum advance value that is allowed when fine learning is active, this will be shown in the logging parameter *Knock Correction (Retard Amount AK)*.
Raising this value will allow the feedback control to add more advance, the default value is 1.05deg and the ECU will not add more than 1.05deg in the event of no knock whilst waiting for the Advance Multiplier to increase.

Fine Ign Learning Advance Magnitude

This is the step size of the Fine Learning when advancing the Ignition Timing. The default value is 0.35deg.

Fine Ign Learning Max Retard

The maximum retard value that is allowed when fine learning is active, this will be shown in the logging parameter *Knock Correction (Retard Amount AK)*.
Increasing this value will allow the feedback control to remove more Ignition (retarding the timing further), the default value is -4.9deg and the ECU will not retard the Ignition more than this in the event of continuous engine knocking. Some tuners reduce this value to prevent the ECU from removing too much timing.

Fine Ign Learning Retard Magnitude #1/ #2

This is the amount of retard applied in the event of feedback control knock. The default value is 1.40deg so the Ignition will be retarded in 1.40deg steps whilst knocking is occurring. Increasing this value from 1.4 to 4.0deg will mean the fine learning will be more aggressive when it removes ignition timing.

Fine Ign Learning Rpm Min/Max

The minimum and maximum Engine Speed (RPM) for the ECU to store the Fine Ignition Learning.

Fine Ign Learning Eng. Load Min/Max

The minimum and maximum Engine Load for the ECU to store the Fine Ignition Learning.

3.3. Cam Timing

Live Data related parameters:

- *VVT Intake Advance Angle Amount L and R*
- *VVT Exhaust Retard Angle L and R*
- *OCV Intake Duty L and R*
- *OCV Exhaust Duty L and R*

3.3.1. Cam Control

There are 3 maps to control the intake and exhaust cams.
Which map is chosen depends on the way the driver demands engine torque and the speed at which the engine load changes.
When gently pressing the accelerator pedal the Low Load map will be used, when quickly flooring the pedal the Full Load map will be used.

3.3.2. Intake Cams

- Intake Cam Advance Low Load* – This map is used at Light Load conditions for low emissions and good fuel consumption.
- Intake Cam Advance Medium to Full Load – This map is used during normal driving conditions and is continued to be used on Full Load as long as smooth and progressive throttle is applied.
- Intake Cam Advance Full Load – This map is used when a sudden high torque demand is made by the driver by aggressive movements of the Accel pedal.

3.3.3. Exhaust Cams

- Exhaust Cam Advance Low Load* – This map is used at Light Load conditions for low emissions and good fuel consumption.
- Exhaust Cam Advance Medium to Full Load – This map is used during normal driving conditions and is continued to be used on Full Load as long as smooth and progressive throttle is applied.
- Exhaust Cam Advance Full Load – This map is used when a sudden high torque demand is made by the driver by aggressive movements of the Accel pedal.

* If using full time Speed Density then the Low Load maps should be set the same as the other two maps – see Speed Density section for more information

3.3.4. Cam Compensation maps

Inlet and Exhaust Cam compensation maps are used to change the cam target for a given coolant temperature, on the WRX this will reduce the Exhaust Cam overlap when the engine is cold. The Inlet maps have not been calibrated at this time.

3.4. Torque, Accelerator and Throttle

Live Data related parameters:

- *Desired Torque (requires RaceROM)*
- *Torque Proportion of Max (requires RaceROM)*
- *Accelerator Position - Relative*
- *Throttle Opening Angle*
- *Throttle Position - Relative*

3.4.1. Accel Pedal to Desired Torque

These maps define the desired engine torque output for a set Engine Speed and Accelerator position. There is one map for each SI Drive mode, when SI Drive is not fitted then the 2nd map is normally used. If you alter an **Accel Pedal to Desired Torque** map then ensure you set the corresponding Trustful map the same.

3.4.2. Wide Open Throttle to Torque

This map is used to calculate the percentage of maximum torque. When the driver torque demand reaches this torque threshold (in Nm) then the throttle butterfly will be fully open.
Raising these values could stop you from achieving full throttle butterfly opening.
Reducing these values would mean the throttle butterfly would be open further for the same accelerator position (Torque Demand amount). Ensure both maps are set the same.

3.4.3. Desired Torque to Throttle

The angle to which open the throttle for a given desired torque. The desired torque is expressed as a percentage of the maximum torque obtained at wide open throttle.

3.4.4. Torque Limiters

There are various torque limiters in the ECU and these can vary depending on the exact model and region. These limiters can restrict the throttle butterfly opening (maximum allowed torque) for a given Engine Speed, Air temp or even the Advance Multiplier. Some torque limiters may have undefined axis but they can be raised if the ECU is closing the throttle in some situations.

3.4.5. Overrun Target Mass Airflow

This is the target mass airflow during gear change and deceleration. This map can cause the rev hang issue found on the manual gearbox WRX models. Reducing these values will reduce the rev hang issue on WRX and will increase engine braking during lift-off (deceleration).

3.4.6. Throttle Target Airflow (inc Trustful)

The throttle target airflow for a given desired torque. The desired torque is expressed as a percentage of the maximum torque obtained at wide open throttle. Ensure the values in this map are pasted into the corresponding Trustful map.
This map can cause the throttle to close during power runs, see the tuning section for guidance on this issue.
Please also see the "Wide Open Throttle to Torque" map and “Throttle Target Angle”.

3.4.7. Throttle Target Angle

Converts the output of the map called “Throttle Target Airflow” to a final throttle angle.
Increasing these values will provide a greater throttle opening angle for the given airflow.

3.5. Boost Control

3.5.1. Desired Boost

This map controls the amount of boost pressure that the ECU tries to achieve, based on RPM and desired torque (Nm). The pressure is in bar absolute. You can simply increase the target boost required for a given RPM and torque and the boost pressure will increase (assuming the wastegate duty can achieve the boost required). It is wise to tail off boost at high RPMs to preserve engine reliability.

3.5.2. Boost Compensation and Limiters

Desired Boost - Atmospheric pressure Compensation

Controls how desired boost pressure is scaled depending on the current atmospheric pressure. See that the boost target is reduced even at sea level at higher RPM

Desired Boost - IAT Compensation

Controls how desired boost pressure is altered depending on the intake air temperature.

Boost Limit

Determines the boost limit based on the engine RPM.
If the boost limiting is triggered, fuel cut will occur to protect the engine.

3.5.3. Wastegate Duty

Initial Wastegate Duty

The initial duty cycle values to achieve ‘Desired Boost’. This map references both RPM and desired torque (Nm). The wastegate duty chosen from this map is then altered by compensation maps for atmospheric pressure, temperature and turbo dynamics, before being applied to the actuator. It is recommended that the Wastegate Initial map values are always set about 10% below that of the corresponding Max Wastegate values.

It can be helpful to use lesser duty cycles values as throttle position decreases to make the car ‘more linear’ in relation to throttle input (Be sure to scale all related maps accordingly).

Maximum Wastegate Duty

This map controls the maximum wastegate duty that the ECU can use for a given RPM and throttle position. The values in this map must be great enough to permit the required boost to be achieved, but low enough so as not to allow overboost to occur.

Wastegate Duty - Atmospheric Pressure Compensation

Controls how the duty cycle is scaled, according to the current atmospheric pressure.
At high atmospheric pressures, it is easier for the turbo to build boost, since the air it is compressing is denser. This means that a lower duty cycle is required at sea level for example, when compared with higher altitudes, in order to achieve the same boost pressure. The turbo’s are also very small and easily over speeded so the Desired Boost and WG Duty will often be reduced at high altitude to protect the maximum turbo speed that is achieved. See that the WG Duty is reduced even at sea level at higher RPM.

Wastegate Duty - IAT Compensation

Controls how the duty cycle is scaled according to the intake air temperature.
At low temperatures the air is denser, meaning that a lower duty cycle is required in order to produce a given level of boost.

3.5.4. Turbo Dynamics

These maps control the rate at which the wastegate duty cycle is altered in order to produce the desired level of boost. These maps determine the percentage of wastegate duty that is added or subtracted from the current duty, based on the magnitude of error between actual boost and desired boost.

Small values in these maps will cause the boost to build very slowly, but are very safe, since there will be no over boost. Higher values in these maps will causes boost to rise more aggressively, but must be carefully set to ensure that over boost and oscillation do not occur.

Proportional Component

Initial values of compensation are taken from this map to give a burst of duty when stamping on the throttle for example.

Larger values can be helpful for increasing the response with larger turbochargers.

Integral Positive & Negative

These maps add or subtract duty cycle depending on how long the boost error has persisted for, as well as how large the error is. The values in these maps are small, but help to maintain faster responding control of boost. Also, there may be two integral maps, split into positive and negative regions. One is used when boost is too high (the negative compensation map); the other is used when boost is too low (the positive compensation map).

When using a different turbocharger or more boost, it may be helpful to modify these maps to achieve proper boost correction without surging.

3.6. Exhaust Gas Recirculation (EGR)

3.6.1. EGR Control

Shown in Live Data as:

- *TGV Drive*
- *TGV Output*
- *TGV Position*
- *EGR Error*
- *EGR No. Steps*

EGR TGV Closed

This shows the target EGR amount whilst the Throttle Generator Valves (TGV) are closed. This would be used at light load and low RPM.

EGR TGV Open

This shows the target EGR amount whilst the Throttle Generator Valves (TGV) are open. This would be used at medium to full load.

EGR – Temperature Compensation

The coolant temperature compensation for EGR control maps. Setting this map to 0% will disable the EGR maps.

3.7. Other Maps

3.7.1. Limiters

Shown in Live Data as:

- *Engine Speed*
- *Vehicle Speed*
- *Fuel Injection #1 Pulse width*
- *Manifold Absolute Pressure*
- *Cruise Control - Memorized*

Speed Limiter

This controls the maximum vehicle speed by reducing the accelerator pedal % when approaching high speeds. It is suggested that the vehicle speed values are all increased by the same amount in all the speed limit maps and that the accel/throttle control is not adjusted.

Speed Limiter minimum RPM

The minimum engine speed for the Speed Limiter to be enabled.

Rev Limit A and B

This controls the engine speed that the fuel injectors will be cut to maintain a set RPM. If the Rev Limit is to be increased by 300rpm then add 300 to all Rev Limit values in Map A and B.

Fuel Cut Resume

When Fuel Cut (Rev Limit) is active the Manifold Pressure must drop below this threshold before the Fuel Injection will be restored (Rev Limit off).

Cruise Speed Limit Min and Max

These are the minimum and maximum vehicle speed limits (km/h) at which the cruise control can be set. Check the Help Text for each map to understand its exact function.

3.7.2. Idle Control

Controlling the Idle speed of an engine is a difficult task and the factory ECU has many targets and compensations to achieve this. The **Idle Target** maps set the target Idle Speed for many different modes like drive, neutral, after starting, engine hot, load on (alternator or headlights etc). It is advised that you adjust all Idle maps by the same amount or simply set them all the same to avoid discrepancies in the idle engine speed.

Target Idle

Desired engine idle speed for a given coolant temperature. If you wish to increase Idle Speed by 150rpm then add 150rpm to all Target Idle maps when coolant temp is over 50deg C.

Idle Stability Control

X axis is RPM idle error
Y axis is rate of change of engine speed
This map is used for Idle Speed error compensation, making the values bigger will make the Idle Speed error more aggressive for correction.

3.8. Sensor Scaling

Shown in Live Data as:

- *Coolant Temperature*
- *Oil Temperature*
- *Intake Air Temperature*
- *Charge Air temperature*
- *Mass Air Flow*
- *Mass Air Flow Sensor*
- *Manifold Absolute Pressure*

MAP Sensor Scaling – Pressure Offset

Manifold Absolute Pressure sensor offset in bar.

MAP Sensor Scaling – Voltage Multiplier

Manifold Absolute Pressure sensor multiplier in bar per volt.

MAF Sensor Scaling

This map can be used to rescale the Mass Air Flow sensor relation between voltage and Mass Air Flow in g/s. Change this value if you have changed the MAF housing or intake system of if your AFR does not match what's in your fuel map.

Air Intake Temperature Sensor Scaling

This map can be used to rescale the intake air temperature sensor voltage to temperature scaling.

Charge Air Intake Temperature Sensor Scaling

This map can be used to rescale the charge air temperature sensor voltage to temperature scaling.

Coolant Temperature Sensor Scaling

This map can be used to rescale the coolant temperature sensor voltage to temperature scaling.

Oil Temperature Sensor Scaling

This map can be used to rescale the oil temperature sensor voltage to temperature scaling.

AF Sensor Scaling

This map converts the AF Sensor current draw (in milliamp) to an AFR value, there should not be any reason to change these maps.

3.9. Diagnostic Trouble Codes

This table can be used to turn off any DTCs like catalyst efficiency and fuel tank pressure sensors. Disabling DTCs should be done with care and understanding.

Example, if you disconnect the coolant sensor the engine will default to a 75 deg C coolant temp and run reasonably well, if you turn off the Coolant temp DTC then the ECU will use the Coolant temp sensor input and assume -40 deg C

Enabled Diagnostic Trouble Codes

Enables/Disables the DTC from showing.

4. Tuning

4.1. Tuning Questions – Hints and Tips

4.1.1. Which ROM version to use?

All ROM versions are shown under HELP, FEATURE & LICENCE INFORMATION and SUPPORTED ECUs. Only use the ROM that is specified for your region.
Make sure you base your tuning on the latest ROM revision that is available. Hitachi are constantly developing and improving and bug fixing so make the most of their hard work.

Compatible ROMs are shown in the ECU programming window, the latest ROM file to use is normally quite obvious through numerical and alphabetical increments, see below for some USA WRX examples, the LV9N_101C and 101D are the latest versions to use (CVT or MT dependant)

2015 USA WRX Manual Model – latest ROM to use at this time is LV9N101C and it has improved knock control.

LV9N101D	
LV9N100D	Improvement of knock control
LV9N002D	Improvement of knock control, P0420, P2610, P0134
LV9N001D	Improvement of knock control, P0420, P2610, P0134, P0606
LV9N000D	Improvement of knock control, P0420, P2610, P0134, P0606

2015 USA WRX CVT Model – latest ROM to use at this time is LV9N101C and it has improved knock control.

LV9N101C	
LV9N100C	Improvement of knock control
LV9N001C	Improvement of knock control, P0420, P2610, P0134
LV9N000C	Improvement of knock control, P0420, P2610, P0134, P0606

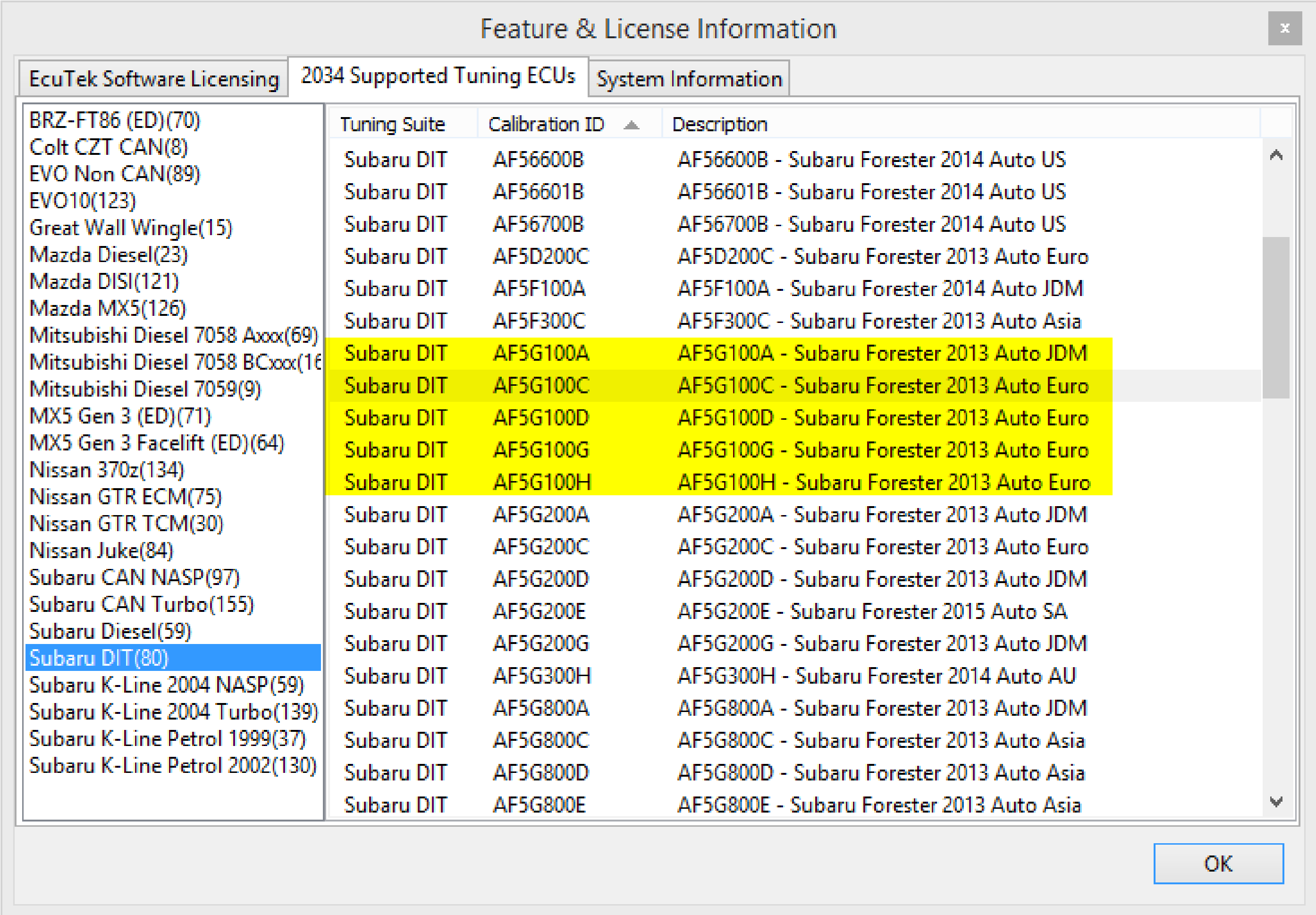
2015 USA Forester CVT Model – latest ROM to use at this time is LF61600B with improved knock control.

LF61600B	
LF61500B	Improvement of knock control, P0300
LF61400B	Improvement of knock control, P0300, P0420
LF61200B	Improvement of knock control, P0300, P0420, P0606

2014 USA Forester CVT Model – the latest ROM to use at this time is AF56C00B with many attempts to solve various different issues it seems. AF53100B to AF56700B are not listed for purpose of explanation simplicity.

AF56C00B	
AF56B00B	Improvement of knock control, P0300,
AF56A00B	Improvement of knock control, P0300, P0420
AF569Z0B	Improvement of knock control, P0300, P0420, Extended engine cranking, P0606
AF56700B	Improvement of knock control, P0300, P0420, Extended engine cranking, P0606
AF54300B	Improvement of knock control, P0300, P0420, Extended engine cranking, P0606
AF53100B	Improvement of knock control, P0300, P0420, Extended engine cranking, P0606

Other regions worldwide comply with similar update structure, here we can see the latest EURO region ECU ROM for the 2013 Forester is the AF5G100H, which replaces the 100A, 100C, 100D and 100G earlier variants). See the Supported ECU list found in ProECU for further assistance.



4.1.2. What's special about the later revisions and why should I use them?

We do not always know what's been changed on later revisions but Hitachi will be constantly fixing and improving the calibration and the code. We know some early Foresters have suffered from engine damage and that later ROM revisions can help avoid this problem so use the latest ROM available.

4.1.3. Can I flash my ECU back to stock?

Yes simply select a standard ROM file from the DIT directory and program this into your ECU, ensure that you do NOT have any comment written in the Comment Field though.
Then CAL ID and CVN number will be original again but the licence and registration information will remain in the ECU.

4.1.4. Can the dealer over flash my tuned ECU?

No, the dealer reflash tool (or other tuning tools) cannot over flash the ProECU tuned ROM. If you flash back a 100% stock ROM, then any other tools can flash over the ECU.

4.1.5. How to recover a part programmed ECU after a programming failure?

In the event that the ECU programming sequence fails (like laptop power dies or vehicle interface becomes disconnected during programming) don't worry as ProECU can recover the ECU. But you will need to 'Manually Select the Vehicle or Select Single ECU Type' in ProECU under the TOOLS menu. It is very important that you select the correct vehicle or ECU type. The WRX and Levorg are 2MB ROM size and the correct Programming window must be opened for the recovery to be successful, you must also choose a 100% stock ROM file for the recovery sequence to work as expected. The Forester and Legacy are only 1.5MB and again the correct Programming Window must be accessed for the recovery to work , see the ProECU Programming Overview.pdf' HELP file for further information.

4.1.6. Is the VVT working after programming?

Always make sure the Inlet and Exhaust VVT is working!! After starting the engine the Exhaust cam takes some time to become active, up to 30 seconds. If a power test is made whilst the Exhaust VVT is not active then a significant amount of power and torque will be lost. After starting, allow the vehicle to Idle for 20-30 seconds until Closed Loop is achieved and Fuel Trim Short Term becomes active, then gently lift the RPM and watch the Exhaust VVT angle in the LIVE DATA window, once it starts to move then you can make your tests.

4.1.7. Can I tune for Ethanol E85 or Flex-Fuel?

Yes, using custom maps the DI open time can be calibrated for any given Ethanol content ratio. See the Ethanol Tuning section later in this manual.

4.1.8. Can I disable Fuel Trims in open loop?

Yes, simply set the AF Correction #3 Target Compensation maps to zero as shown in the fuelling section.

4.1.9. Can I use Closed Loop on full load?

Yes it's possible to run Closed Loop on full load but at this time we advise against this until further testing has been made, see the Fuelling and MAF Tuning sections for further info.

4.1.10. How much Ignition Advance can I run?

The DIT runs very little timing advance compared to older STI models and even the more recent BRZ/ FR-S/86 models. Even with its lower 10.6:1 Compression Ratio the new DIT engine design does not allow us to run the sort of timing advance you would expect on a BRZ FI model or a STI so watch carefully.

The Intercooler seems particularly inefficient and you can watch the Charge Air Temp climb during a power run or pull on the road. Running a richer AFR will also help keep the engine quiet.

4.1.11. Which Ignition maps work in Mode 1?

In "Mode 1", the ECU will use the original Base Ignition Timing and Ignition Advance map strategy labelled as TGV and VVT ON/OFF. In mode 2 and 3, the ECU will use the new singular RaceROM Ignition Timing and Ignition Advance maps labelled Mode2 and Mode3 respectively.

4.1.12. Why does the throttle close during a power run?

If the throttle angle reduces during a pull through the rpm range then copy and paste the values on the right hand side of the map called Throttle Target Airflow one or two cells to the left, see the throttle tuning section for further information.

4.1.13. Is the ECU Learning cleared after programming?

No the ECU Reset is not carried out after an ECU programming sequence, the ECU Reset procedure can be carried out by selecting the ECU Reset feature from the Tuning Tools menu.

4.1.14. How much power can I make with the DI system?

At this time the Direct Injection pump flow seems to be the inherent weakness, unlike other DI fuel systems it seems we cannot get significant increase in fuel pressure (or more importantly fuel volume) delivery from the stock fuel pump, this will be OK on lesser power models like FXT and WRX but the LGT at 300PS from the factory will be limited in the future. Our current calculations show the DI pump can only supply enough fuel for around 340bhp. See the DI tuning section to get the most from the DI system.

4.1.15. Using RaceROM features on models fitted with Subaru Eyesight.

You may experience system errors when using RaceROM Map Switching or Boost Controller on models fitted with the new Subaru Eyesight – Driver Assist Technology.
We strongly recommend that the vehicle is actually driven and the RaceROM features are tested thoroughly for compatibility in each instance. If any errors occur then the RaceROM features should be disabled and should NOT be used.

4.2. How to Setup...

4.2.1. How to setup an Intake or Induction Kit

It's very important that the ECU knows the true amount of mass airflow (grams per second) that is entering the engine so it can accurately calculate the correct volume of fuel to inject and therefore achieve the correct AFR that's shown in the fuel map.

The factory fuel map has been calibrated to a stock factory intake and the values in the fuel map are what the vehicle runs when the mass airflow entering the engine is accurate.

Generally when fitting aftermarket Intakes, induction kits or even replacement panel filters, the MAF sensor reading will be altered and the MAF sensor scaling will need adjusting.

Generally the Inside Diameter (ID) of an aftermarket MAF tube will be larger than the stock MAF tube ID. Most Intakes will change the way the air flows through the MAF tube and thus across the MAF sensor itself. This results in a lower MAF sensor voltage output that is given to the engine ECU for the same mass airflow. This lower mass airflow reading will lead to a lower engine load, more advanced Ignition timing and a leaner AFR. It's very important that the MAF scaling is adjusted (normally increased) to counteract this problem.

The preferred setup would be making a 'before and after' log file showing the MAF volts, mass airflow, engine load, AFR etc for the stock intake and then new intake, you can then cross reference the MAF Volts 'before and after' for each RPM and Manifold Pressure and increase the MAF Sensor scaling right hand column (grams) until the same mass airflow reading is achieved with the new intake compared to the old intake.

Now this doesn't always happen and quite often the car already has an Intake fitted so the Fuel Trims will be very important and can be used to make the MAF calibration.

It's important to remember how the DIT uses Open loop and Closed Loop control on this engine. Please see below for a recap from the Fuelling section earlier in this manual.

The **Fuel Map – Open Loop Lo Det** and **Fuel Map – Open Loop Hi Det** are the main tables that set the Target AFR and also determine if Closed or Open loop fuelling will be used:

- A 14.7 value in the **Fuel Map Lo Det** indicates that the ECU should work in a Closed Loop mode condition and the Target AFR value is selected from one of the maps called **Fuel Map – Closed Loop #1 - #5** (FTST is working).
- A value lower than 14.7 **Fuel Map – Open Loop Lo Det** indicates that the ECU should work in Open Loop mode condition the target AFR value comes from the **Fuel Map – Open Loop Lo Det** map itself (FTST is NOT working).

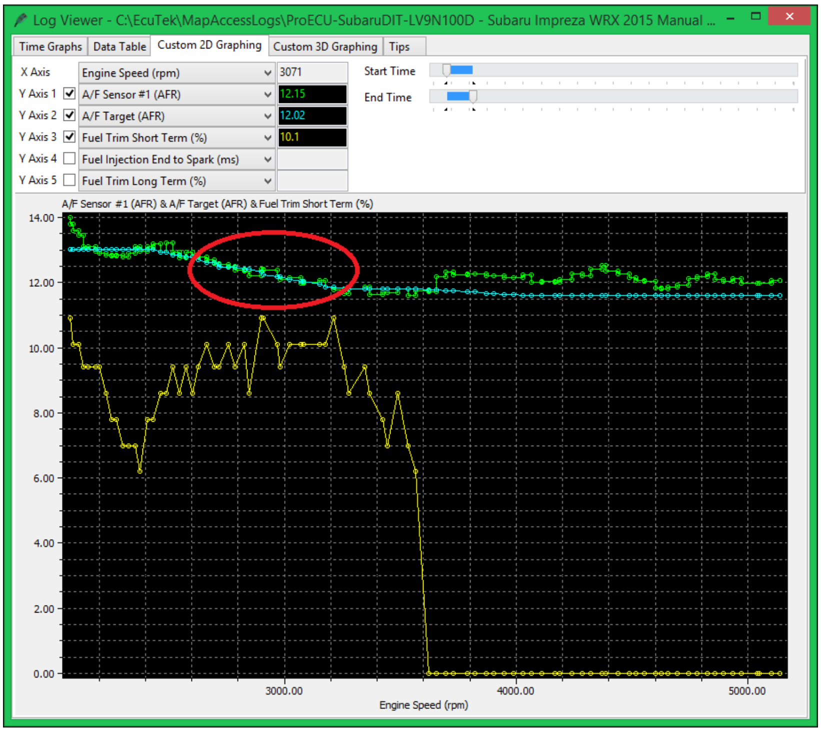
When the ECU switches from a Closed Loop condition to an Open Loop then there are timers and transitional ramp rates that must be considered and appreciated.

**** IMPORTANT ****

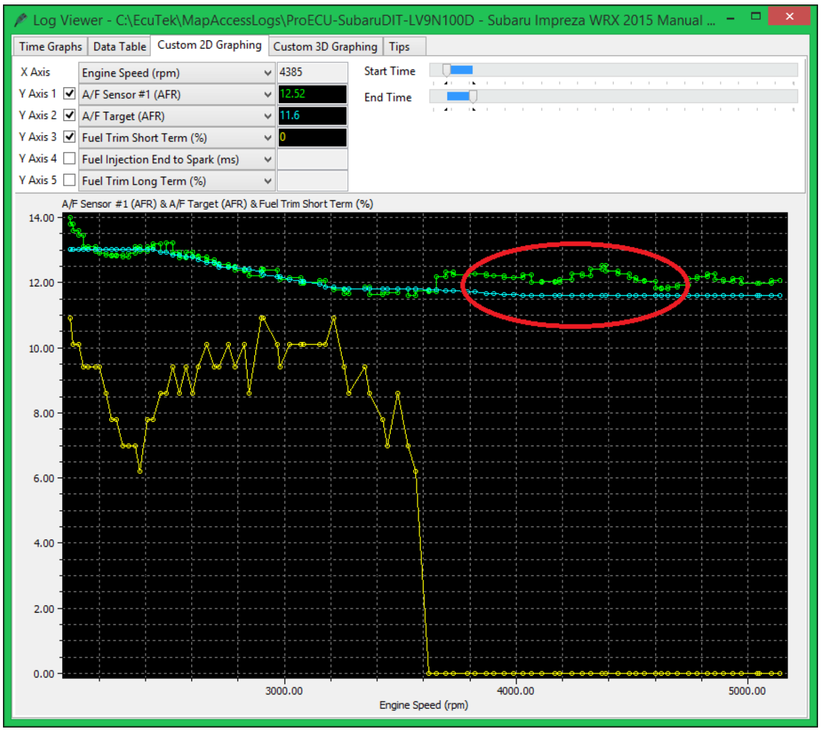
The ECU will target 14.7:1 AFR when switching from Closed to Open Loop mode, it will ignore any richer Target AFR values in the Closed or Open Loop fuel maps.

In the following log file screenshots we have simulated fitting a larger MAF housing, this will mean that for a given airflow the AFM voltage will be lower/less when the larger housing is fitted (as the airflow will be slower). So with the larger MAF housing fitted the Mass Airflow (gms) will be less and therefore the Engine Load will be lower which will mean more advanced ignition timing lookup but also we will have a leaner AFR as the ECU calculates fuel delivery volume based on airflow.

Closed Loop Log File: In this example at 3000rpm you can see the AF Target and AF Sensor #1 are very close at 12:1 AFR, the ECU is working in Closed Loop and the FTST (Yellow line) is currently showing 10% indicating the ECU is ADDING +10% to the Injector Open Time to hit the Target AFR



Open Loop Log File: In this next example at 4300rpm you can see the AF Target is 11.6:1 but the actual AF Sensor #1 reading is 12.5:1, its running lean!
The FTST (Yellow line) is at zero indicating the ECU is working in Open Loop.



So when the MAF Scaling is out during Closed Loop the FTST will compensate and ADD Fueling to hit the Target AFR, when the ECU is in Open Loop then FTST will NOT work and the AFR will be lean.
The solution is to increase the MAF Scaling in this region and this process is described as follows.

4.2.2. Adjusting the MAF scaling in Open Loop

So the point to note is the Short Term Fuel Trims do not work in Open Loop so MAF scaling in Open Loop is shown below.

To make a good MAF scaling we should fill the right hand side of the fuel map with a safe and friendly AFR, we will choose 12:1 AFR like shown below. Now make a power test and once the Engine Load exceeds 0.80 (r/rev) then the AFR should be 12:1.

Now you need to ensure the FTST is zero so the car is in Open Loop, you can force the ECU to Open Loop by setting the **Fuel Map – Open Loop Lo Det** map at less than 14.7:1 AFR, see previous page.
So for this particular test and to make a power run at 12:1 AFR we suggest you reduce the boost pressure as the AFR at 12:1 is quite lean but is written for example purpose only. After the power run is made then open the log file and check the AF sensor reading and ideally compare to your aftermarket wideband sensor (remember that ProECU can import the Innovate LM2 sensor).

If the AFR is 14:1, then increase the MAF scaling (g/sec) at that particular MAF voltage.

If the AFR is 10:1, then reduce the MAF scaling (g/sec) at that particular MAF voltage.

With a 12:1 Target then aim to get the AFR within 11.5:1 and 12.5:1 AFR across the board, good tuners will aim for 11.8 to 12.2 AFR but it depends on the time you have available. The first time you make a MAF scaling in this way, it may take a while but once you master it then in future you will be tweaking the MAF curve on every flash. Once the MAF scaling is good and smooth and you have 12:1 across the power curve, then you can profile the fuel map to your preferred AFRs.

MAKE SURE that your Engine Load does not exceed the X axis of the Fuel and Ignition maps, if it does then rescale the maps or use our Example Maps as your base file to start your tuning.

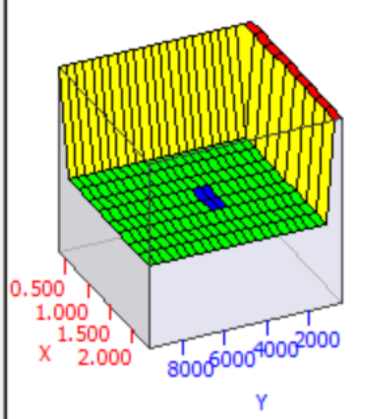
AE8MB00A-enc.bin - Fuel Map - Open Loop Lo Det

File Edit View Plot Help

1.600 Engine Load (g/rev) 12.0 AFR

Engine Speed (RPM)

4800	0.350	0.800	1.00	1.20	1.40	1.60	1.80	2.000	2.200	2.400
400	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
800	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
1200	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
1600	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
2000	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
2400	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
2800	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
3200	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
3600	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
4000	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
4400	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
4800	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
5200	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
5600	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
6000	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
6400	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
6800	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
7200	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
7600	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
8000	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
8400	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
8800	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
9200	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02
9600	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.02	12.02	12.02



4.2.3. Adjusting the MAF scaling in Closed Loop

At Idle and light load (Closed Loop condition) the Fuel Trim Short Term (FTST) and Fuel Trim Long Term (FTLT) will typically be adding +5% to -5% to maintain the closed loop target.
When we fit a new Intake this will change and the FT will reflect the amount of compensation needed to the MAF scaling to keep the FT tight within 5%.

As the DIT has better closed loop control than previous Subaru models (like BRZ/FR-S and STI) and we can use this closed loop feedback to help with our MAF scaling.

So as per the Fuelling section earlier in the manual it possible to adjust the **Fuel Map – Open Loop Lo Det** map and set the car to Closed Loop on full load as shown below.

You can see the **Fuel Map – Open Loop Lo Det** map is filled with 14.7:1 and the **Fuel Map – Closed Loop #4** is filled with 12:1.
This will make the ECU use the FT to control the AFR at 12:1 and the FT can be logged and viewed to help adjust the MAF scaling.
This feature should be used with caution and understanding though and we do not recommend running in Closed Loop on Full Load all the time.

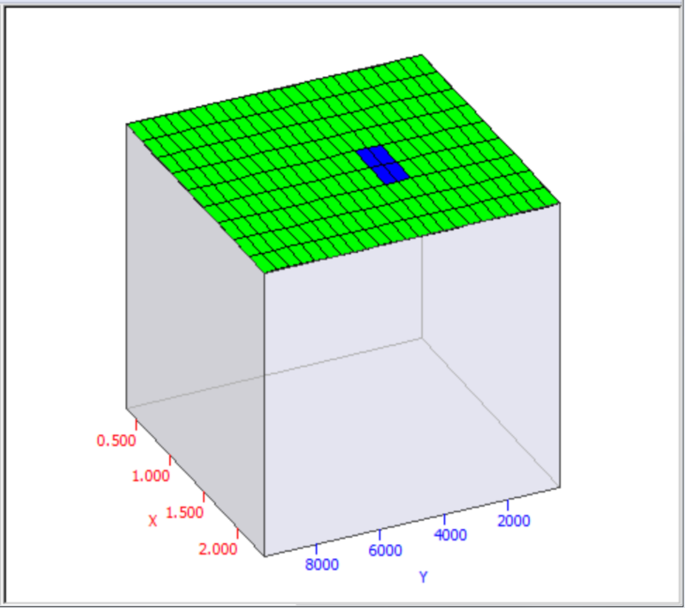
AE8MB00A-enc.bin - Fuel Map - Open Loop Lo Det

File Edit View Plot Help

1.600 — Engine Load (g/rev) — 14.7 AFR

Engine Speed (RPM)

4000	0.350	0.800	1.00	1.20	1.40	1.60	1.80	2.000	2.200	2.400
400	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
800	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
1200	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
1600	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
2000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
2400	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
2800	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
3200	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
3600	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
4000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
4400	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
4800	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
5200	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
5600	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
6000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
6400	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
6800	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
7200	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
7600	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
8000	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
8400	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
8800	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
9200	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70
9600	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.70	14.70	14.70



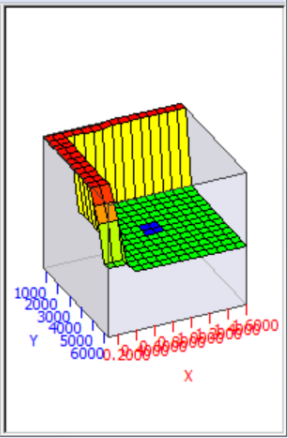
AE8MB00A-enc.bin - Fuel Map - Closed Loop #4

File Edit View Plot Help

0.9000 — Engine Load (g/rev) — 12.0 AFR

Engine Speed (RPM)

3600	0.1000	0.200	0.300	0.400	0.50	0.600	0.700	0.800	0.900	1.00	1.10	1.200	1.300	1.400	1.500	1.600
700	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.7	14.7	14.7	14.7	14.70	14.70	14.70	14.70	14.70
800	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.7	14.7	14.7	14.7	14.70	14.70	14.70	14.70	14.70
1200	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
1600	14.7	14.7	14.7	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
2000	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
2400	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
2800	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
3200	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
3600	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
4000	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
4400	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
4800	14.6	14.6	14.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
5200	14.1	14.1	14.1	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
5600	13.6	13.6	13.6	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
6000	12.3	12.3	12.3	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00
6400	12.3	12.3	12.3	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.00	12.00	12.00	12.00	12.00



4.2.4. Adjusting the Direct Injector Firing Angle

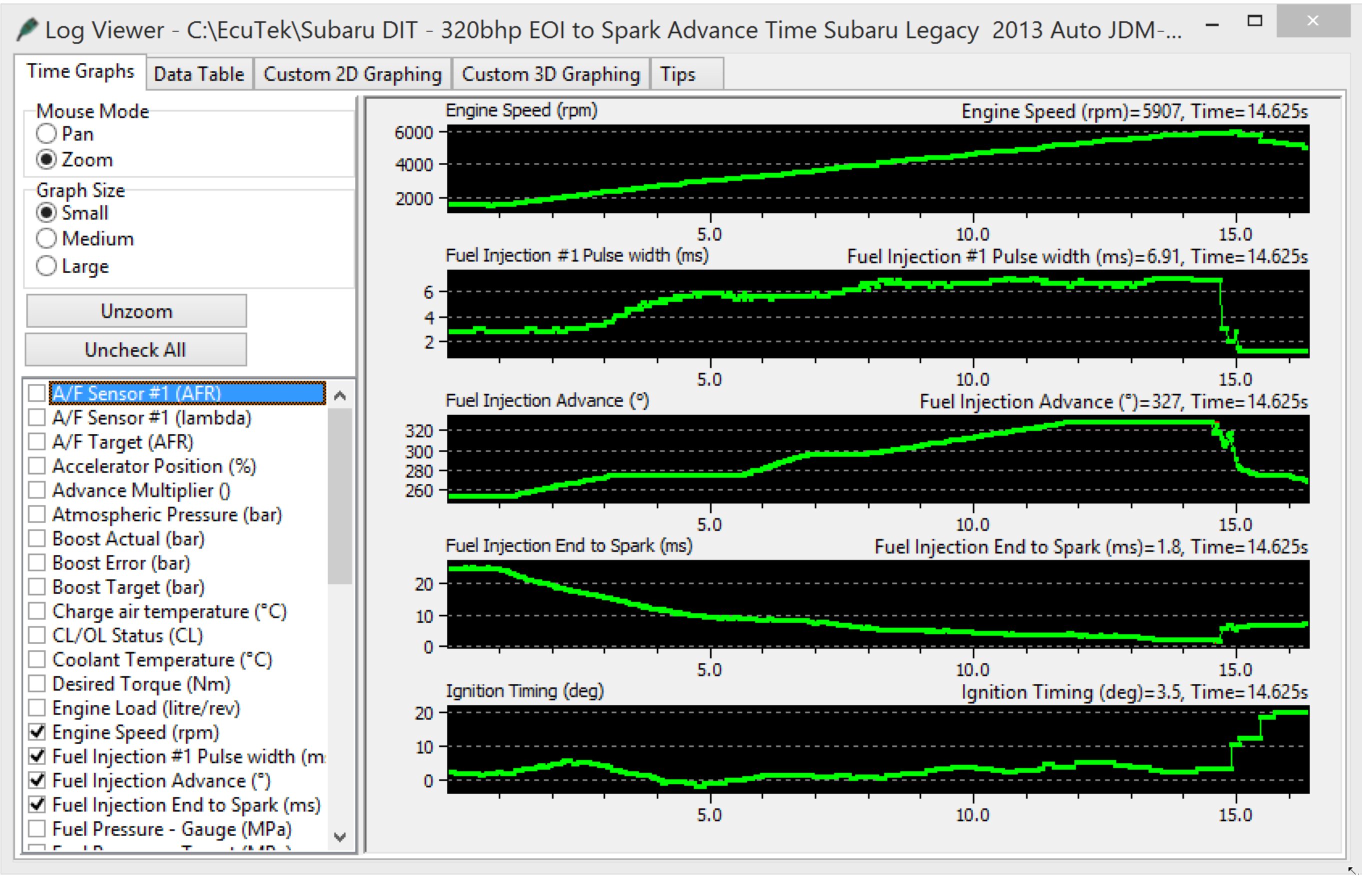
The Direct Injector Angle map (called Fuel Injection Angle Base) shows the Start Of Injection (SOI) angle in crankshaft degrees before TDC (spark plug firing).
This will be followed by the End Of Injection (EOI) when the Direct Injector will actually close.
The time period that the DI is actually open for is controlled by the Fuel Map Target AFR and how much fuel volume is required to achieve that AFR for a given fuel pressure.

The Fuel Injection Angle map shows the SOI angle is crank degrees before TDC spark firing (not TDC valve overlap).

- 180 deg will mean SOI will commence at BDC (end of the Induction stroke and start of the Compression stroke).
- 270 deg will mean SOI will commence half way down the Induction stroke with the piston heading down for BDC.
- 360 deg will mean SOI will commence at TDC during Inlet and Exhaust valve overlap phase (the start of the Induction stroke and end of the Exhaust stroke).

There are four main logging parameters to consider here:

- Fuel Injection Advance – This is the crank angle (deg) before TDC (spark plug firing) that the DI will commence SOI.
- Fuel Injection #1 Pulse Width – the total time period is (ms) that the DI is open for.
- Fuel Injection End to Spark – This is the time period (ms) between the EOI and the spark plug firing (Ignition Timing), there must always be a time period between EOI and the spark plug firing.



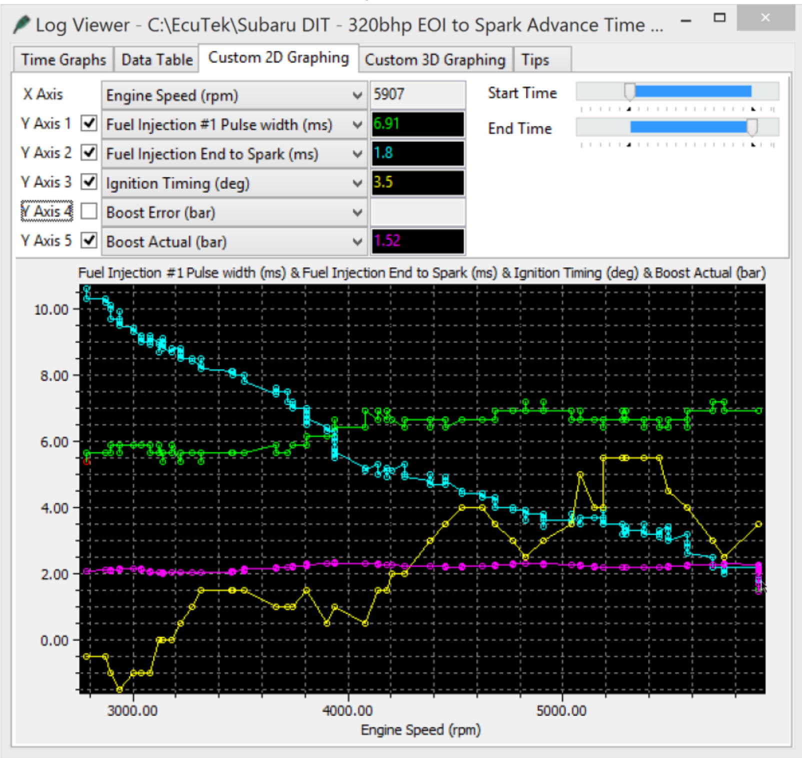
As the DI can only inject during Induction and Compression strokes the total amount of DI open time is half of what a port injector could be (as port injectors can be open during all four strokes). But the DI open time period is also limited by:

- Valve Overlap – If DI starts to early then the fuel could end up in the exhaust system.
- Ignition Timing – EOI must happen before the spark plug fires.

So valve overlap needs to be considered before the SOI, at high RPM (6000+rpm) you would expect to see the Direct Injection Angle (SOI) set at 340 to 370deg, this is during valve overlap but the piston is moving so fast that no fuel will travel into the exhaust system.

In addition the Injection phase must be finished (EOI) before the spark plug fires, remember that the spark plug often fires BEFORE TDC and an Ignition Timing value of 25deg will mean the piston is still rising on the compression stroke when the plug fires so this limits the total time period that the Injector can actually inject.

For tuning we need to be able to measure the time period left between EOI and the spark plug firing, this is the logging parameter called '*Fuel Injection End to Spark*', this is the time period (ms) between EOI and the spark plug firing.



This is a very important logging parameter and it's logged by default in the latest RRFF, monitor this closely whilst tuning.

The actual DI open time is dynamic, the AFR Target is constantly changing due to closed loop control, fuel pressure and even knocking.

The Ignition Timing is also dynamic with Advance Multiplier and Knocking Correction all affecting the final spark advance angle and limiting the available time period that the DI can inject for.

The two log file screen shots above show the 'Fuel Injection Spark to End' as 1.8ms at 6000rpm and the 'Fuel Injection Pulse Width' is open for 6.91ms, the DI firing angle at 327deg BTDC.

So at 6000rpm the engine take 10ms for one revolution (5ms per stroke), so the maximum DI period (Fuel Injection Pulse Width) would be 10ms.

But allowing for valve overlap (DI angle at 327deg BTDC) and spark advance at 3.5deg BTDC then 10ms DI Open Time is simply not possible and we can see the free time between EOI and Ignition Timing firing is down to 1.8ms (Fuel Injection End to Spark logging parameter).

If the 'Fuel Injection End to Spark' time period is less than 0.5ms then misfiring will be experienced as the DI is open whilst the spark plug fires!

This logging parameter should never be less than 1ms in our opinion to give the fuel time to mix before the spark event. If more fuel is required then you can tweak several factors to increase this time period (though all have limiting factors):

- Increase Fuel Pressure by 1MPa so the Fuel Injector open time period (ms) will be less due to the higher demanded fuel pressure, the Fuel Pressure can only be increased by a small amount before the high pressure fuel pump is beyond capacity.
- Increase the Fuel Injector Angle map values at higher RPM which will start the injection period earlier (only at the RPM where there is no free time left), the SOI angle can only be pushed so far before it will inject fuel when the exhaust value is still open (though reducing the values in the Exhaust VVT map will means the Exhaust VVT closes earlier so less chance of fresh charge entering the exhaust.
- Lean the Fuel Map slightly which will reduce the DI open Time period though watch for knocking.
- Reduce Target Boost Pressure so less fuel injector open time is required.

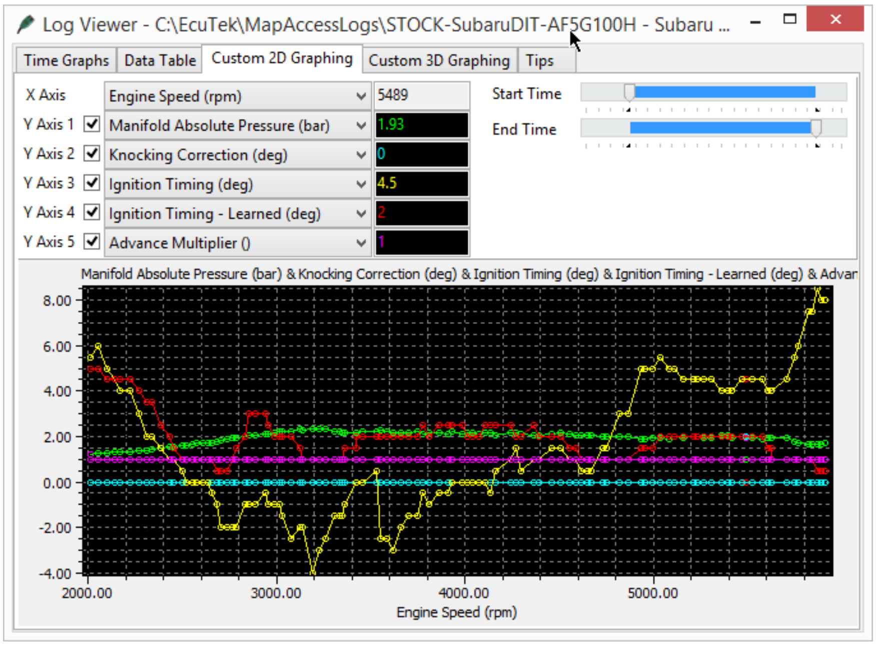
Tweaking all of the above should ensure you have sufficient 'free time period' for maximum power.

4.2.5. Ignition Timing Control

The Ignition control and dynamic advance system is very similar to older Subaru's from 2005 to 2015. The DIT engine runs very little Igniting advance on full load compared to other Subaru's like EJ25 or even the high compression BRZ/GT86 with a turbo fitted!

The DIT is very sensitive to Ignition timing and like most Subaru's it runs on the edge of knock most of the time.

Spending time to understand the Ignition control is really important so you can understand what's going on and make a good safe calibration.



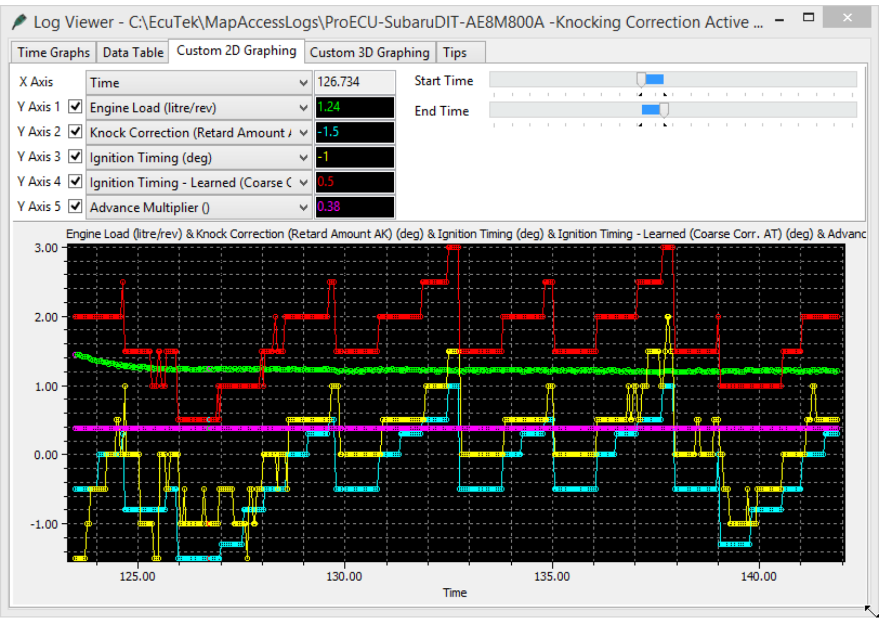
See the log file on the left, the Yellow line (Ignition Timing) is only 4.5deg BTDC at 5500rpm and the ignition timing is actually -4deg (ATDC) at peak torque.

The knock control and fine learning are very active and can at times seem too sensitive.

Charge air temp is again a significant and limiting factor and the factory Intercooler becomes saturated on two simple power runs.

Charge Air Temps over 70deg C are not uncommon at higher RPM.

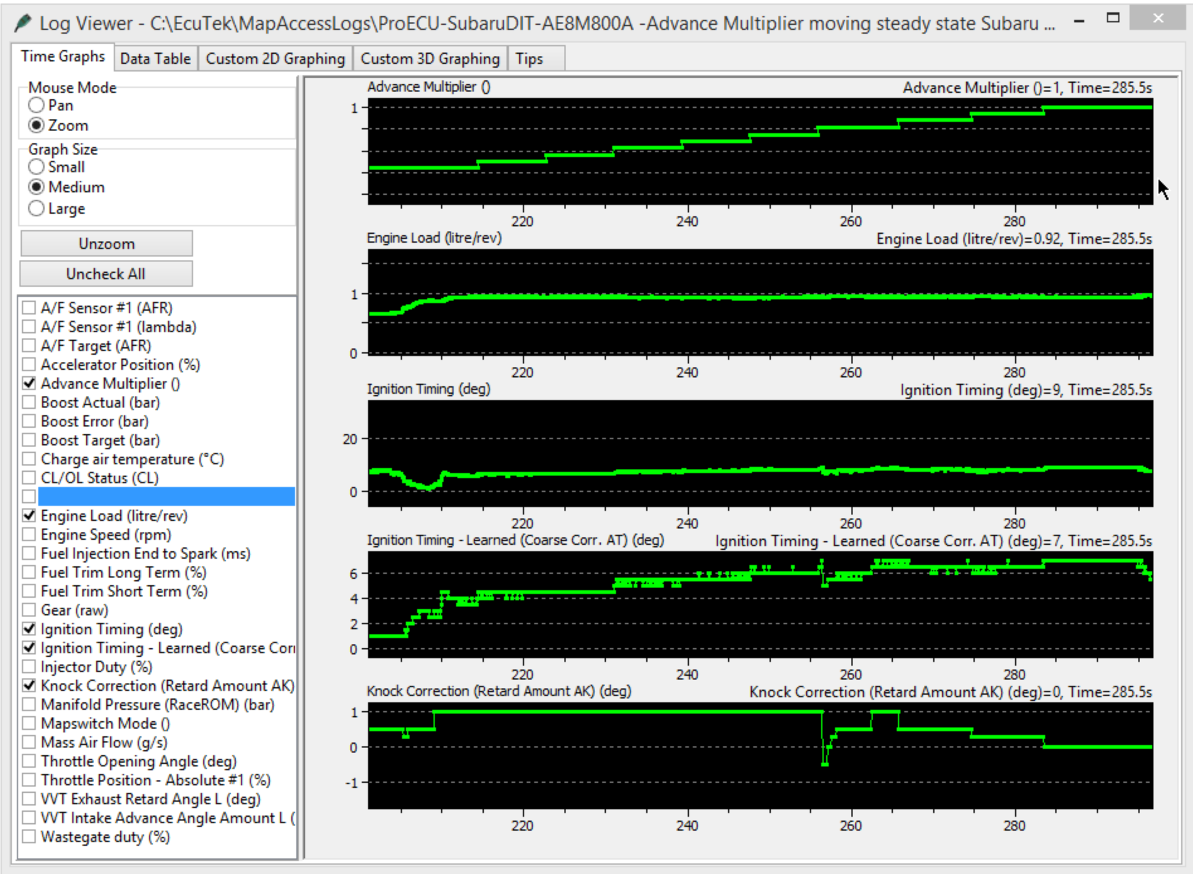
In this next example you can see the Fine Learning (Knock Correction Retard Amount AK) trying to advance the Ignition and raise the Advance Multiplier (down at only 0.38).



The Cyan coloured line shows AK cycling and building advance from -1.5 deg to a positive +1deg only to knock then start the cycle all over again.

You can also see the Red coloured line *Ignition Timing Learned* value (AT) increasing and decreasing as the Fine Learning is added and subtracted whilst exploring the knock limit.

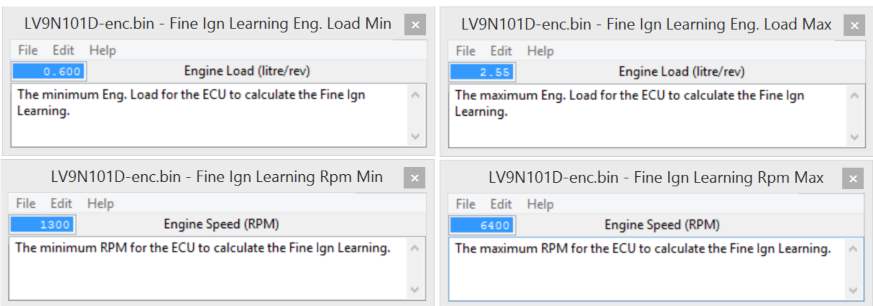
In this next example you can see the engine is held on load, stead state and that the *Advance Multiplier* is climbing from 0.44 to 1 over a 70 second time period. You can see the *Ignition Timing Learned (AT)* also increasing from 3.5 to 7deg over the 1 minute period. Remember that AT is the output of the *Ignition Advance* map multiplied by the AM, so as the AM rises so does the Ignition Learned value. As a result the Ignition timing advanced from 5.5deg to 9deg.



You can see that the *Knock Correct (AK)* value was positive (greater than zero) whilst the AM was climbing, this is the fine learning /dynamic advance working. AK adds positive advance and in the vent of no knocking the AM climbs.

Here are some facts to consider:

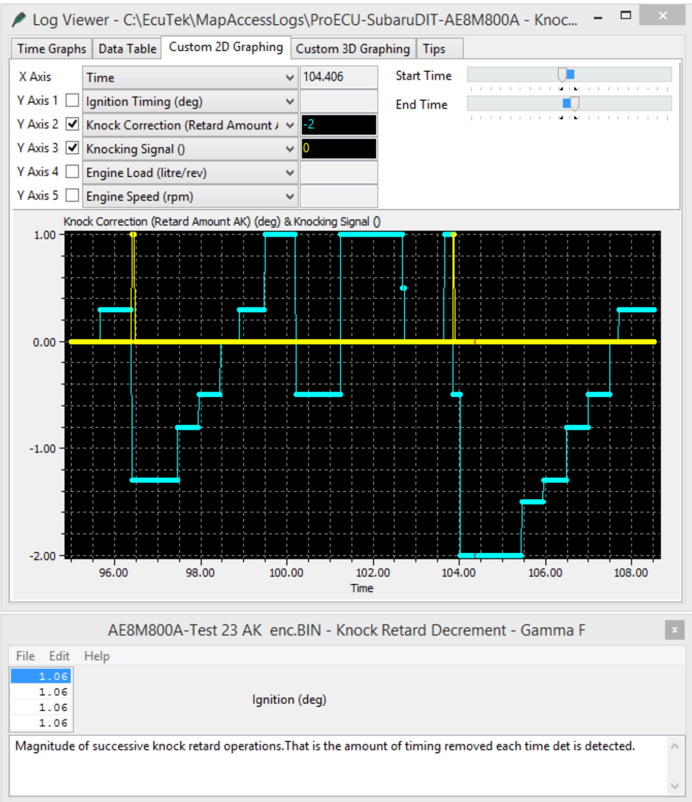
- The Ignition Advance maps are multiplied by the AM before being added to the Ignition base maps, so larger values in the Ign Adv maps will have a greater effect on the ignition timing when the AM changes, smaller values in the Ign Adv maps will have a smaller effect on the ignition timing when the AM changes.
- Different Knock Sensitivity maps will be selected relative to the Advance Multiplier (maps called Knock Sensitivity Ign Adv. Hysteresis and Threshold).
- On WRX the Ignition Advance Maps #1 and #2 are added together then added to the base map relative to the 2d maps called *Ignition Advance – AM Factor #1/#2*.
- Make sure that the actual Engine Load does not exceed the X axis Engine Load scaling on the Ignition maps, if it does then rescale all the Ignition maps.

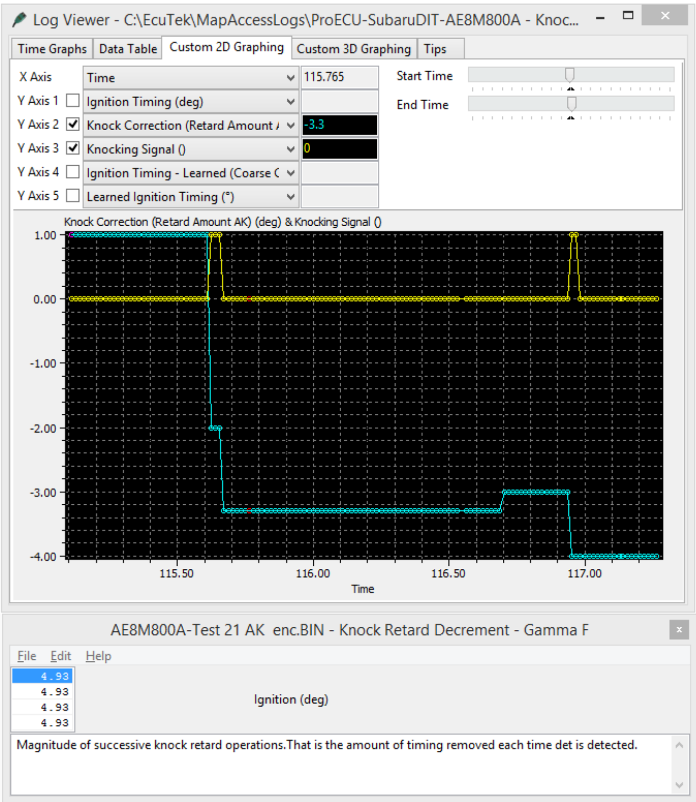


The thresholds above control the minimum and maximum Engine Speed (RPM) and Engine Load that the ECU is allowed to calculate and store the Fine Ignition Learning, these can be used to prevent the ECU from removing and stored Ignition Retard unnecessarily.

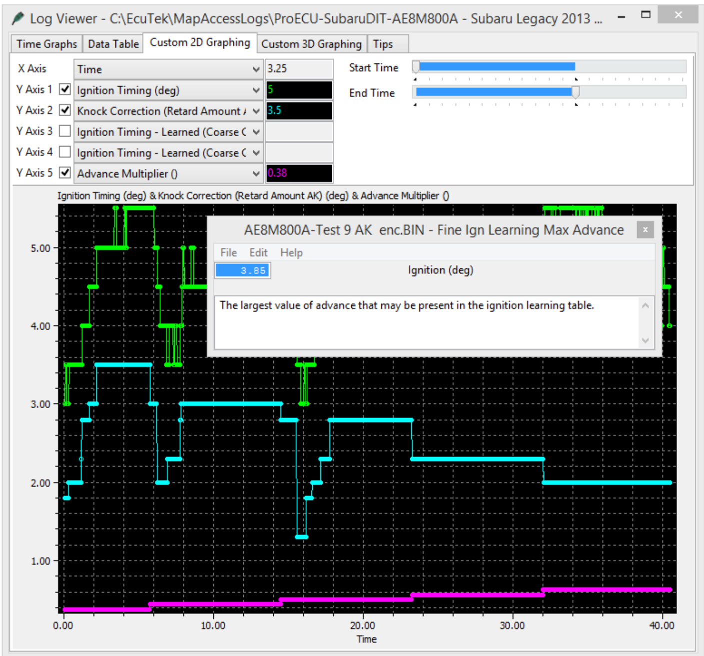
Knock Retard Control

You can see below that the map called *Knock Retard Decrement* value has been calibrated at 1.06deg and 4.93deg for purpose of example.
When the *Knocking Signal* value moves from 0 to 1 this indicates that knocking is taking place.





The left hand side shows the small amount of retard applied when the knocking signal becomes active, with AK showing -1deg.
The right hand side shows a much larger retard amount is applied when the knocking signal becomes active with AK showing -3.3deg.
You can also see that for subsequent knock signal events that AK will reduce further.
This is a severe test but it has been to show the knock control in more detail.
See the following example.

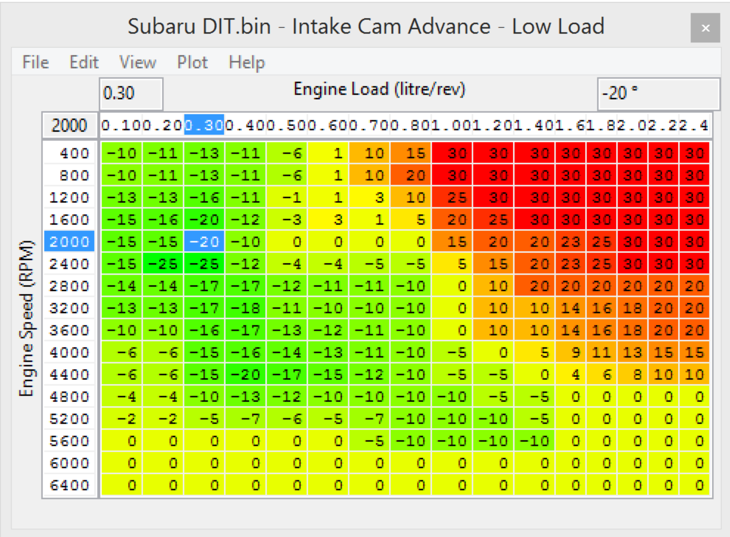


Raising the value in the map called *Fine Ignition Learning Max Advance* will allow the ECU to add more than 1deg of advance.

See the example to the side where the Max Advance value has been increased from 1.05deg to 3.85deg and Knock Correction AK (Cyan line) is adding +3.5deg whilst the AM is climbing (Purple line).

4.2.6. Cam Tuning for Power and Speed Density

As seen below the 'Low Load' maps have significant overlap at light load and low RPM which reduces cylinder fill but also forces spent exhaust gas to be pushed into the Inlet port, this is known as internal EGR and is designed to reduce emissions.
But this exaggerated cam overlap will reduce the manifold depression in the plenum/inlet manifold, this causes problems when running on Speed Density as SD is a Manifold Pressure based calculation and Engine Load will be higher than it should be causing rich AFR and retarded Ignition Timing.



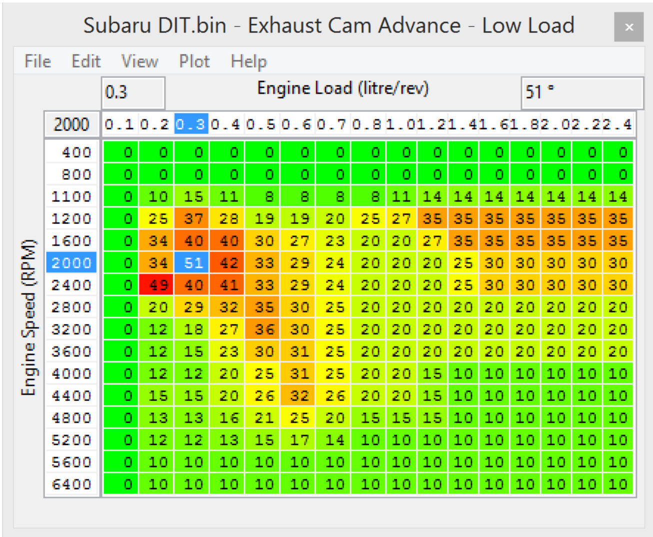
Subaru DIT.bin - Intake Cam Advance - Low Load

File Edit View Plot Help

0.30 | Engine Load (litre/rev) | -20 °

Engine Speed (RPM)

2000	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	1.00	1.20	1.40	1.6	1.8	2.0	2.2	2.4
400	-10	-11	-13	-11	-6	1	10	15	30	30	30	30	30	30	30	30
800	-10	-11	-13	-11	-6	1	10	20	30	30	30	30	30	30	30	30
1200	-13	-13	-16	-11	-1	1	3	10	25	30	30	30	30	30	30	30
1600	-15	-16	-20	-12	-3	3	1	5	20	25	30	30	30	30	30	30
2000	-15	-15	-20	-10	0	0	0	0	15	20	20	23	25	30	30	30
2400	-15	-25	-25	-12	-4	-4	-5	-5	5	15	20	23	25	30	30	30
2800	-14	-14	-17	-17	-12	-11	-11	-10	0	10	20	20	20	20	20	20
3200	-13	-13	-17	-18	-11	-10	-10	-10	0	10	10	14	16	18	20	20
3600	-10	-10	-16	-17	-13	-12	-11	-10	0	10	10	14	16	18	20	20
4000	-6	-6	-15	-16	-14	-13	-11	-10	-5	0	5	9	11	13	15	15
4400	-6	-6	-15	-20	-17	-15	-12	-10	-5	-5	0	4	6	8	10	10
4800	-4	-4	-10	-13	-12	-10	-10	-10	-10	-5	-5	0	0	0	0	0
5200	-2	-2	-5	-7	-6	-5	-7	-10	-10	-10	-5	0	0	0	0	0
5600	0	0	0	0	0	0	-5	-10	-10	-10	-10	0	0	0	0	0
6000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Subaru DIT.bin - Exhaust Cam Advance - Low Load

File Edit View Plot Help

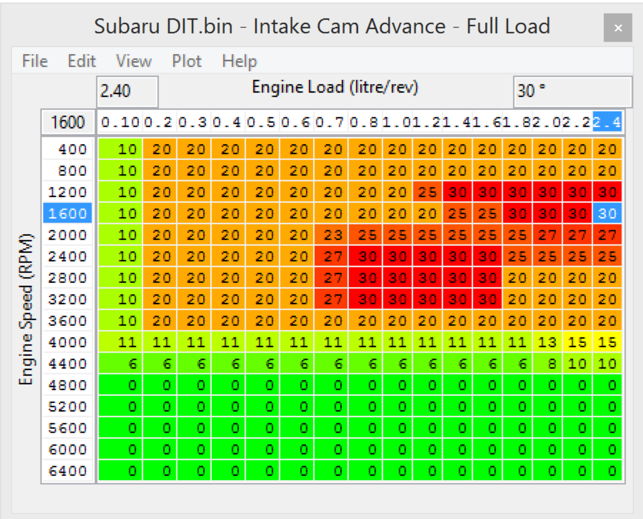
0.3 | Engine Load (litre/rev) | 51 °

Engine Speed (RPM)

2000	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1100	0	10	15	11	8	8	8	8	11	14	14	14	14	14	14	14
1200	0	25	37	28	19	19	20	25	27	35	35	35	35	35	35	35
1600	0	34	40	40	30	27	23	20	20	27	35	35	35	35	35	35
2000	0	34	51	42	33	29	24	20	20	20	25	30	30	30	30	30
2400	0	49	40	41	33	29	24	20	20	20	25	30	30	30	30	30
2800	0	20	29	32	35	30	25	20	20	20	20	20	20	20	20	20
3200	0	12	18	27	36	30	25	20	20	20	20	20	20	20	20	20
3600	0	12	15	23	30	31	25	20	20	20	20	20	20	20	20	20
4000	0	12	12	20	25	31	25	20	20	15	10	10	10	10	10	10
4400	0	15	15	20	26	32	26	20	20	15	10	10	10	10	10	10
4800	0	13	13	16	21	25	20	15	15	15	10	10	10	10	10	10
5200	0	12	12	13	15	17	14	10	10	10	10	10	10	10	10	10
5600	0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
6400	0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

So when using Speed Density at light load/low rpm (or full time SD) the 'Intake Cam Advance – Low Load' map values should be set the same as 'Full Load' or 'Medium to Full Load' Cam Advance maps, this prevents the ECU from entering light load emission phase cycle (instigating Internal EGR) which will cause problems when running on SD.

Tuning for more power, when the accel pedal is moved quickly (immediate high torque request) the ECU will switch to the 'Full Load' cam maps, these have been profiled to provide maximum torque as quickly as possible. You can see from the Intake and Exhaust profiles below that significant advance is used to encourage turbo spool. Raising and extending this values will produce more aggressive spool (increased torque) though dyno testing is required to prove the best results.



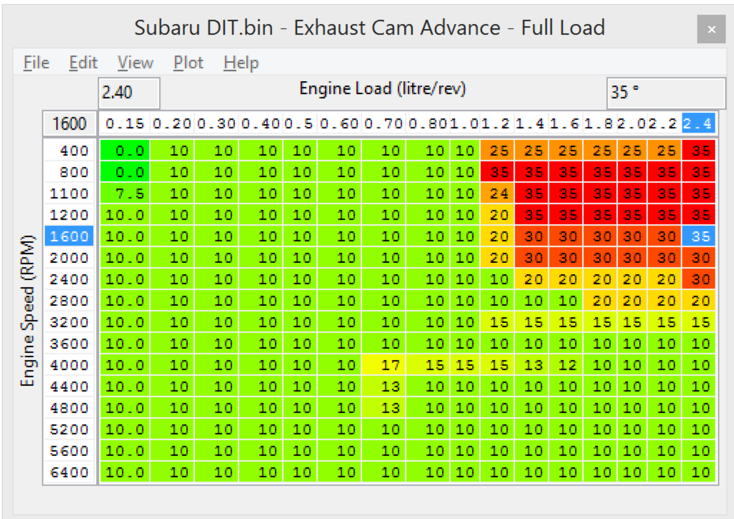
Subaru DIT.bin - Intake Cam Advance - Full Load

File Edit View Plot Help

2.40 | Engine Load (litre/rev) | 30 °

Engine Speed (RPM)

1600	0.10	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
400	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
800	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
1200	10	20	20	20	20	20	20	20	20	25	30	30	30	30	30	30
1600	10	20	20	20	20	20	20	20	20	20	25	25	30	30	30	30
2000	10	20	20	20	20	20	23	25	25	25	25	25	25	27	27	27
2400	10	20	20	20	20	20	27	30	30	30	30	30	25	25	25	25
2800	10	20	20	20	20	20	27	30	30	30	30	30	20	20	20	20
3200	10	20	20	20	20	20	27	30	30	30	30	30	20	20	20	20
3600	10	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
4000	11	11	11	11	11	11	11	11	11	11	11	11	11	13	15	15
4400	6	6	6	6	6	6	6	6	6	6	6	6	6	8	10	10
4800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



Subaru DIT.bin - Exhaust Cam Advance - Full Load

File Edit View Plot Help

2.40 | Engine Load (litre/rev) | 35 °

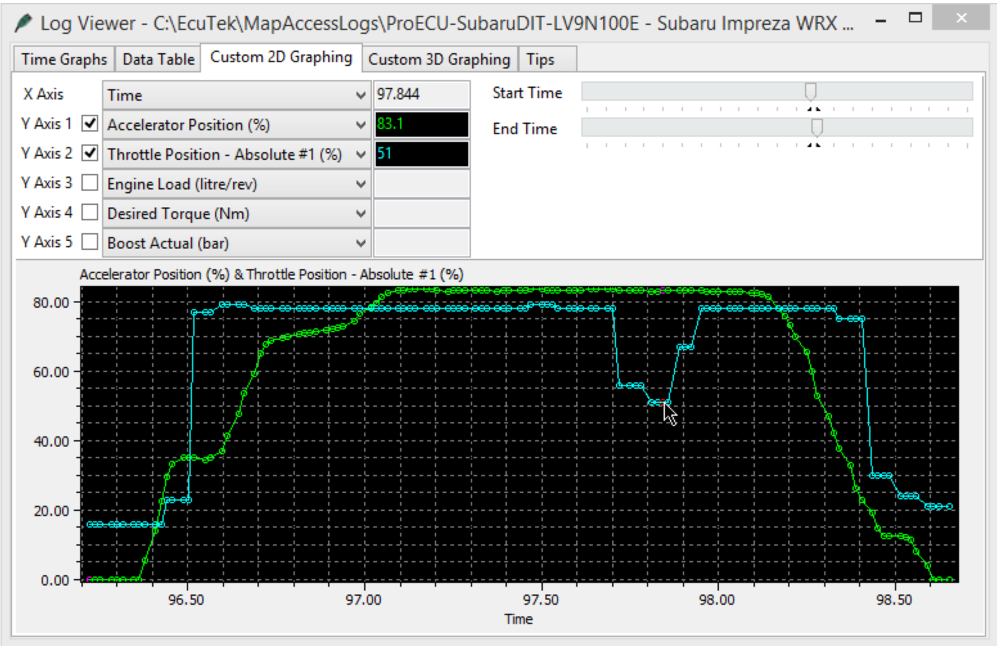
Engine Speed (RPM)

1600	0.15	0.20	0.30	0.40	0.5	0.60	0.70	0.80	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
400	0.0	10	10	10	10	10	10	10	10	25	25	25	25	25	25	35
800	0.0	10	10	10	10	10	10	10	10	35	35	35	35	35	35	35
1100	7.5	10	10	10	10	10	10	10	10	24	35	35	35	35	35	35
1200	10.0	10	10	10	10	10	10	10	10	20	35	35	35	35	35	35
1600	10.0	10	10	10	10	10	10	10	10	20	30	30	30	30	30	35
2000	10.0	10	10	10	10	10	10	10	10	20	30	30	30	30	30	30
2400	10.0	10	10	10	10	10	10	10	10	10	20	20	20	20	20	30
2800	10.0	10	10	10	10	10	10	10	10	10	10	10	20	20	20	20
3200	10.0	10	10	10	10	10	10	10	10	15	15	15	15	15	15	15
3600	10.0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
4000	10.0	10	10	10	10	10	17	15	15	15	13	12	10	10	10	10
4400	10.0	10	10	10	10	10	13	10	10	10	10	10	10	10	10	10
4800	10.0	10	10	10	10	10	13	10	10	10	10	10	10	10	10	10
5200	10.0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
5600	10.0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
6400	10.0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

The boost pressure should be watched closely as it's possible to spool the turbo more quickly (using cam overlap) by allowing the Inlet turbo pressure through the cylinder into the exhaust manifold which will decrease turbo lag but it will not actually produce more torque (as the boost is not in the cylinder but in the exhaust manifold!).

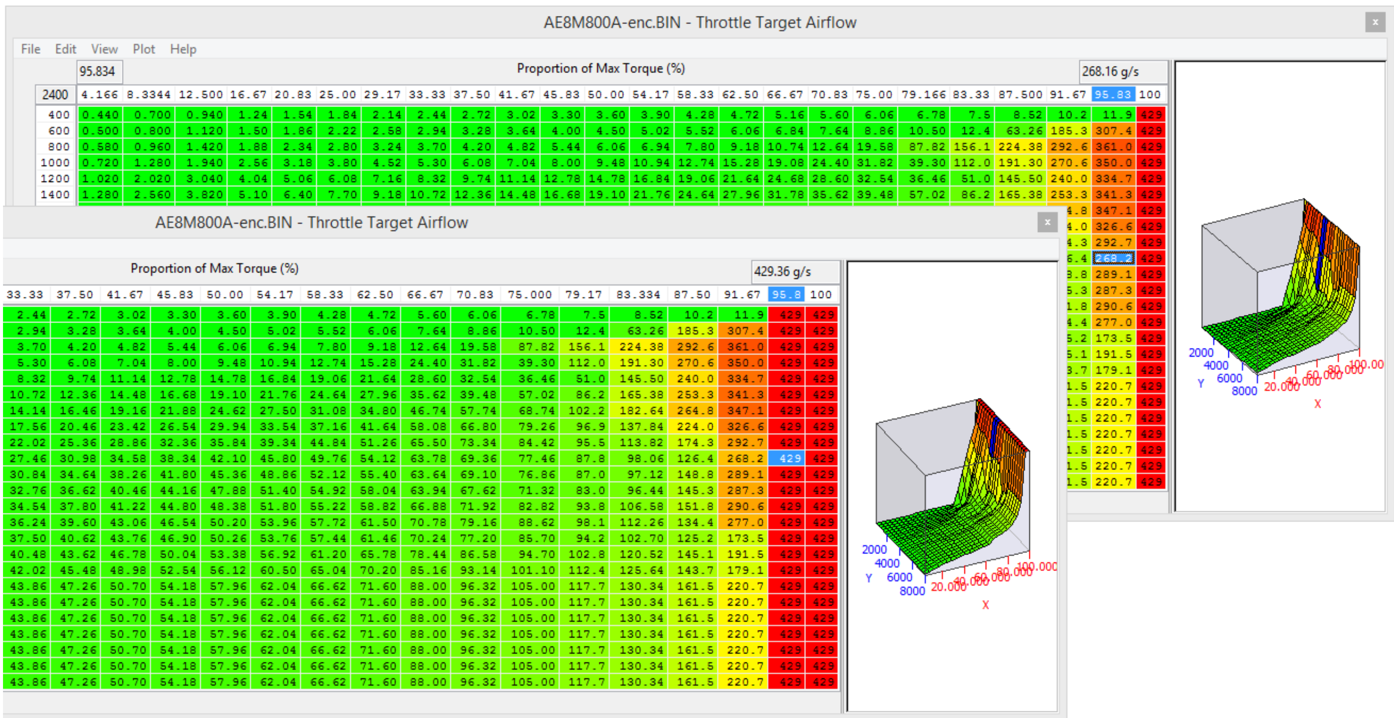
4.2.7. Throttle and Torque tuning

When increasing the boost pressure the torque generated will be higher, if the torque value is too high the ‘Proportion of Max Torque’ can be too high and this can lead to the throttle closing during a power run like shown below. The Desired and Actual Torque can be difficult to cross reference and calculate especially with the added complication of the Wide Open Throttle Torque threshold map that profiles the boost and airflow relationship to the throttle opening angle.

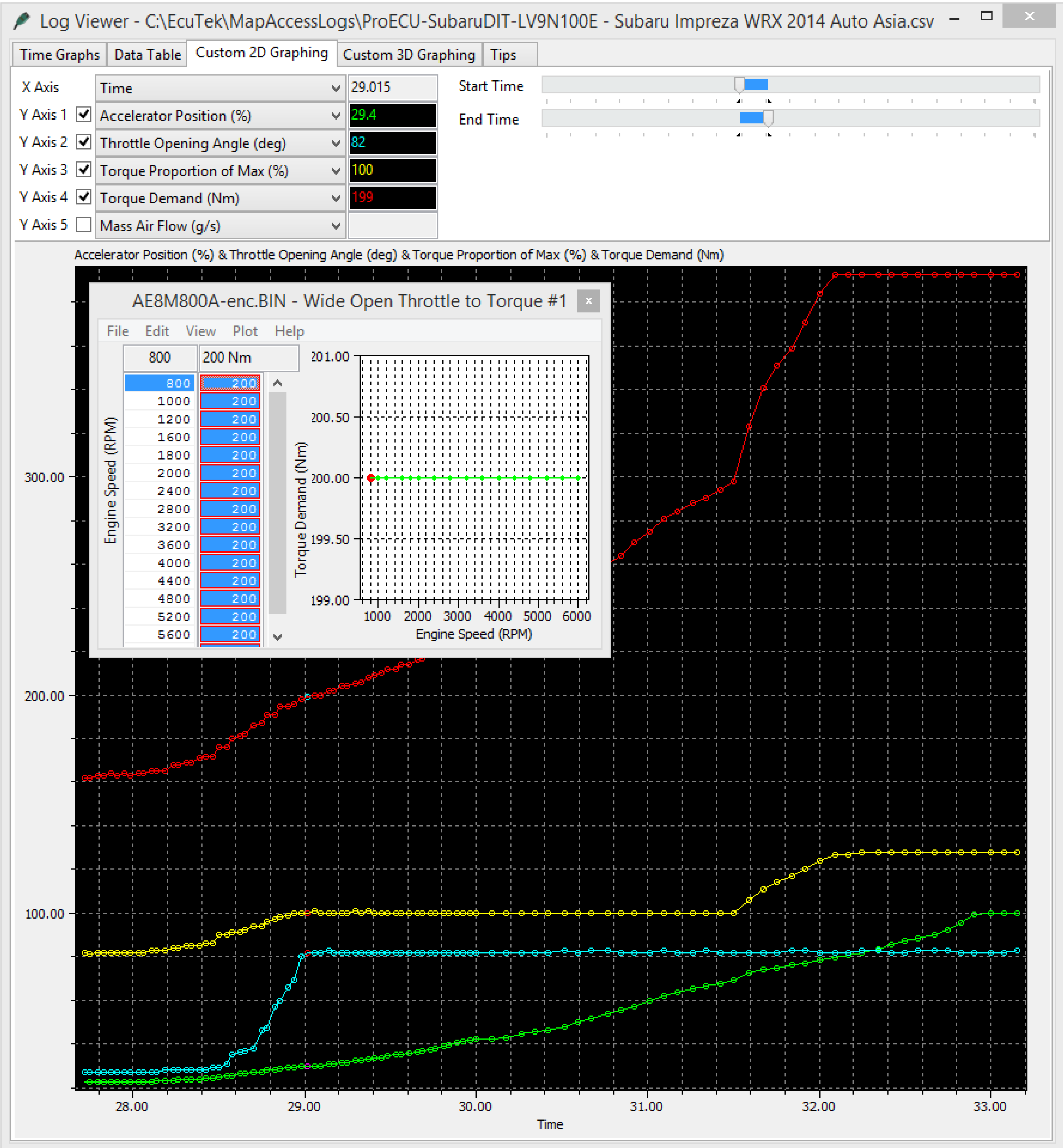


In the latest RRFF there is a new logging parameter called ‘Torque Proportion of Max’, this will show the X axis of the ‘Throttle Target Airflow’ map. When the throttle closes you will see that the new logging parameter will drop below 100% and that the factory setting for the map called Throttle Target Airflow will output a reduced Mass Airflow value resulting in the throttle butterfly closing.

The easiest and most simple way to avoid this annoying issue is to move the values in the map 1 or two cells to the left like shown below, this will keep the throttle open if the Proportion Of Max Torque drops below 100% for any reason.



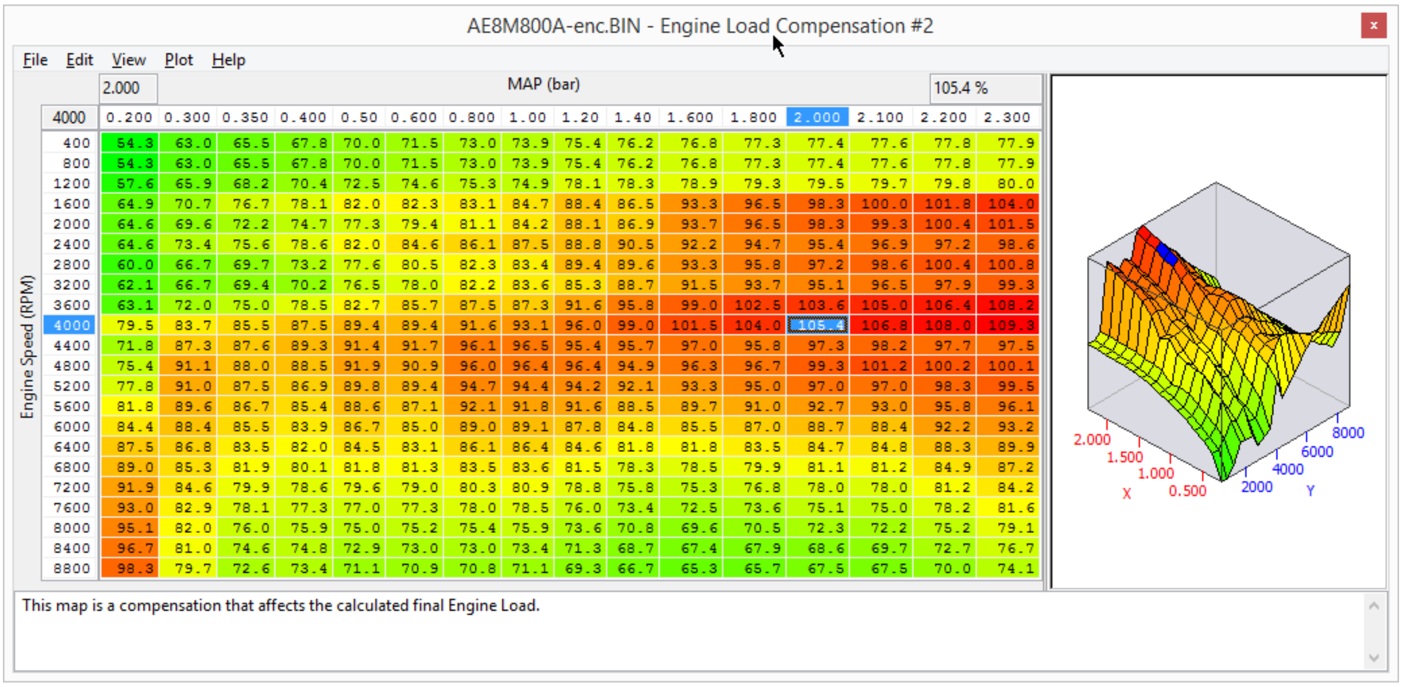
In this particular example below the 2d map called 'Wide Open Throttle to Torque' is filled with 200NM (for example purpose only), this will mean we will have full throttle opening at 200Nm Torque Demand.
This is also 100% Torque Proportion of Maximum (logging parameter).
So you can see that the yellow line shows 100% as soon as the red line (Torque Demand) hit 200Nm, this is also the point when the cyan line (throttle opening angle) is fully open.



You can see as the Accel pedal (green line) is pushed further and even more torque is demanded that at 300Nm the Torque Proportion of Maximum increases even further to 128% though the throttle butterfly can physically open no further than 82 degrees.
The reason it starts to climb again at 300Nm is not known at this time, there may be and additional threshold but it's not really relevant as the throttle is already fully open. Though this is probably linked to the closed loop boost control that uses engine torque calculations.

4.2.8. Engine Load compensation #1 - #2

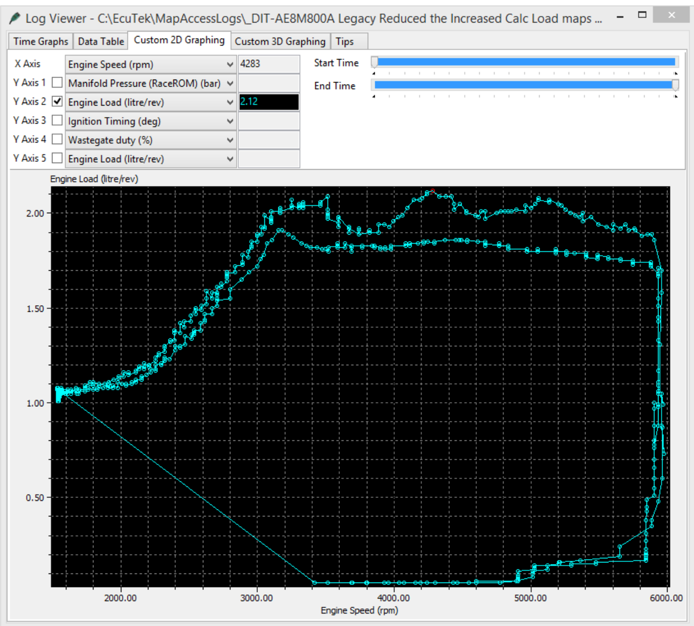
These 3d maps are used a part of a volumetric efficiency calculation to correct the engine load in certain condition.

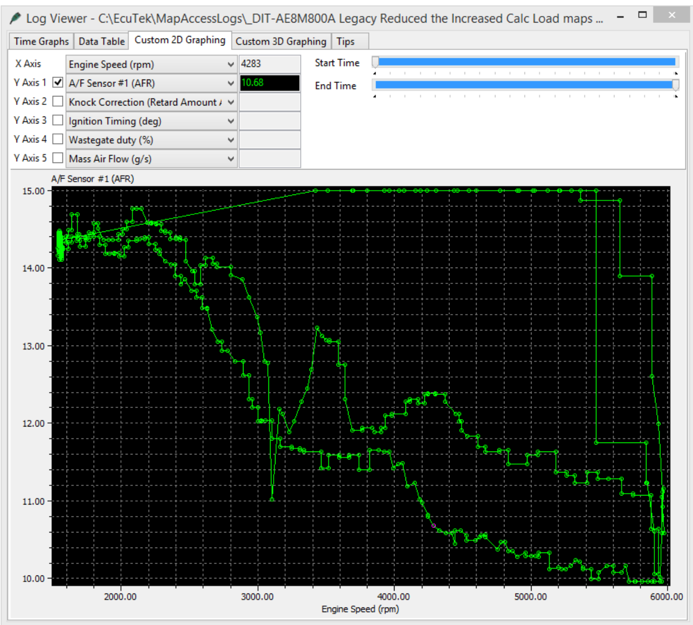


4000	0.200	0.300	0.350	0.400	0.50	0.600	0.800	1.00	1.20	1.40	1.600	1.800	2.000	2.100	2.200	2.300
400	54.3	63.0	65.5	67.8	70.0	71.5	73.0	73.9	75.4	76.2	76.8	77.3	77.4	77.6	77.8	77.9
800	54.3	63.0	65.5	67.8	70.0	71.5	73.0	73.9	75.4	76.2	76.8	77.3	77.4	77.6	77.8	77.9
1200	57.6	65.9	68.2	70.4	72.5	74.6	75.3	74.9	78.1	78.3	78.9	79.3	79.5	79.7	79.8	80.0
1600	64.9	70.7	76.7	78.1	82.0	82.3	83.1	84.7	88.4	86.5	93.3	96.5	98.3	100.0	101.8	104.0
2000	64.6	69.6	72.2	74.7	77.3	79.4	81.1	84.2	88.1	86.9	93.7	96.5	98.3	99.3	100.4	101.5
2400	64.6	73.4	75.6	78.6	82.0	84.6	86.1	87.5	88.8	90.5	92.2	94.7	95.4	96.9	97.2	98.6
2800	60.0	66.7	69.7	73.2	77.6	80.5	82.3	83.4	89.4	89.6	93.3	95.8	97.2	98.6	100.4	100.8
3200	62.1	66.7	69.4	70.2	76.5	78.0	82.2	83.6	85.3	88.7	91.5	93.7	95.1	96.5	97.9	99.3
3600	63.1	72.0	75.0	78.5	82.7	85.7	87.5	87.3	91.6	95.8	99.0	102.5	103.6	105.0	106.4	108.2
4000	79.5	83.7	85.5	87.5	89.4	89.4	91.6	93.1	96.0	99.0	101.5	104.0	105.4	106.8	108.0	109.3
4400	71.8	87.3	87.6	89.3	91.4	91.7	96.1	96.5	95.4	95.7	97.0	95.8	97.3	98.2	97.7	97.5
4800	75.4	91.1	88.0	88.5	91.9	90.9	96.0	96.4	96.4	94.9	96.3	96.7	99.3	101.2	100.2	100.1
5200	77.8	91.0	87.5	86.9	89.8	89.4	94.7	94.4	94.2	92.1	93.3	95.0	97.0	97.0	98.3	99.5
5600	81.8	89.6	86.7	85.4	88.6	87.1	92.1	91.8	91.6	88.5	89.7	91.0	92.7	93.0	95.8	96.1
6000	84.4	88.4	85.5	83.9	86.7	85.0	89.0	89.1	87.8	84.8	85.5	87.0	88.7	88.4	92.2	93.2
6400	87.5	86.8	83.5	82.0	84.5	83.1	86.1	86.4	84.6	81.8	81.8	83.5	84.7	84.8	88.3	89.9
6800	89.0	85.3	81.9	80.1	81.8	81.3	83.5	83.6	81.5	78.3	78.5	79.9	81.1	81.2	84.9	87.2
7200	91.9	84.6	79.9	78.6	79.6	79.0	80.3	80.9	78.8	75.8	75.3	76.8	78.0	78.0	81.2	84.2
7600	93.0	82.9	78.1	77.3	77.0	77.3	78.0	78.5	76.0	73.4	72.5	73.6	75.1	75.0	78.2	81.6
8000	95.1	82.0	76.0	75.9	75.0	75.2	75.4	75.9	73.6	70.8	69.6	70.5	72.3	72.2	75.2	79.1
8400	96.7	81.0	74.6	74.8	72.9	73.0	73.0	73.4	71.3	68.7	67.4	67.9	68.6	69.7	72.7	76.7
8800	98.3	79.7	72.6	73.4	71.1	70.9	70.8	71.1	69.3	66.7	65.3	65.7	67.5	67.5	70.0	74.1

Increasing or decreasing the map values will directly affect Engine Load, Ignition Timing and Injector open time but it does not affect the Mass airflow (as shown in the mass airflow logging parameter).

You can see below the effect on Engine Load and therefore Ignition Timing and AFR, the left hand log shows how the engine load increases when the VE map is increased by 30%, the right hand log shows the change in AFR on full load (in open loop).





These maps can be used to fine tune the engine load to dial out fuelling issues etc that may occur when running on MAF.

4.2.9. How to set up for Ethanol and import a Flex Fuel sensor

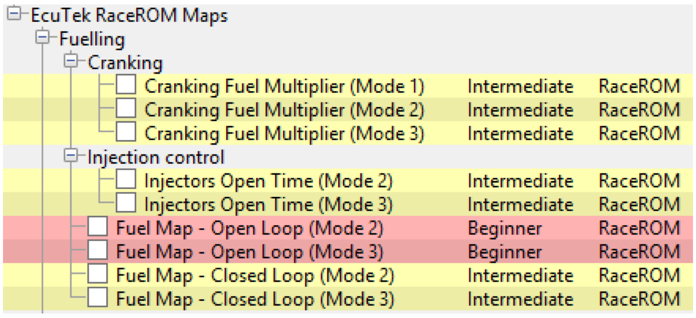
You can tune the Subaru DIT for Ethanol fuel and Flex-Fuel using Custom Maps.
The Fuelling, Ignition and Boost Pressure can all be adjusted for a given Ethanol content.
You can also configure fail safe maps and custom gauge hijacking to show Ethanol content ratio, all this is possible because of Custom Maps, see below:

Fuel Volume

When running on E85 we need to increase the amount of fuel volume that is added per cylinder fill, the extra fuel volume amount required is typically between 25% and 35% and this is calibrated by increasing the Injectors Open Time map by a certain percentage amount (increase all the values by +30% for example).

Cranking Fuel

In addition, cranking fuel is normally a fixed injection volume amount and it needs increasing independently of the main fuel volume calculations. The Cranking Fuel Multiplier maps (against Coolant Temp) should be calibrated to proportionally increase the fuel amount delivered during cranking. 100% is unchanged and 130% would deliver 30% more fuel during cranking.



Fuel Trims Open Loop

We recommend that the rear o2 sensor fuel trims are disabled in open loop, this will prevent the AF Correction #3 from changing over a period of time.

Ignition Timing

Along with extra fuel volume we also need to advance the Ignition timing as Ethanol takes longer to burn and longer to release all its energy, for this reason we needed to advance the timing on full load, an activation threshold can be set so the additional Ignition timing is only added over a certain engine load or manifold pressure for example.

Boost Pressure

The boost pressure target can be increased for a given Ethanol content ratio. You can also reduce the Desired Torque amount against Ethanol ratio (so reduce the boost pressure) when running regular gas or a lower Ethanol % ratio.

Gauge Hijack

The current Ethanol Ratio can also be displayed on the Digital Coolant Temp Gauge during Mapswitch mode or full time* in any of the 3 modes if required (though this may cause problems with gearshift timing on CVT models). See the dedicated Custom Maps manual for further info on setting up Gauge Hijacks.

Flex-Fuel

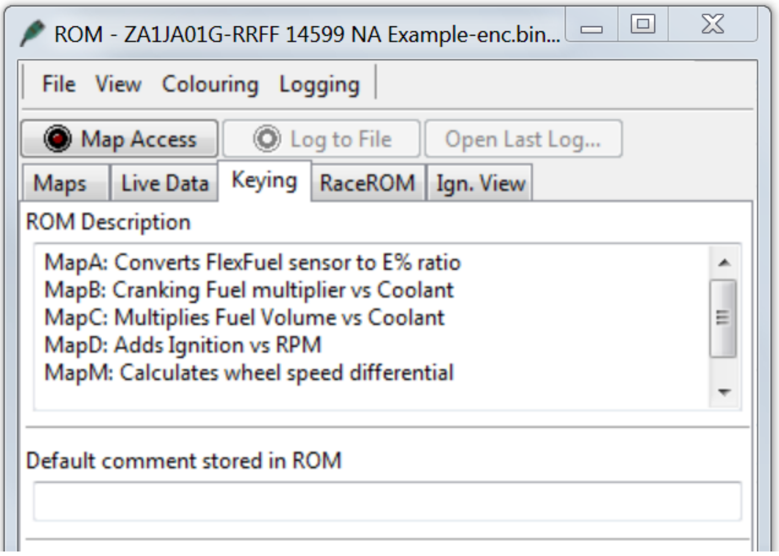
A Flex-Fuel sensor can be imported through the rear O2 sensor, there are a few 'Plug n Play' Flex Fuel kits on the market at this time. The

Importing a Flex-Fuel sensor eliminates the risk of potential engine damage and also avoids having to run an empty tank before refuelling with Ethanol, the tuning will always be correct for whatever the current Ethanol Ratio happens to be.

Considerations

Please consider the fact that you will be injecting +30% more fuel using E85 and you must watch carefully the logging parameter called '*Fuel Injection End to Spark*', this is the 'free time' period (ms) between EOI and Ignition Timing. Demanding more fuel (greater Injector Open Time) and advancing the Ignition Timing (spark advance) means even less time available for the DI to deliver the required volume of fuel.

The BRZ/FR-S example ROMs show the 4 custom maps that we changed:



- Map A - Converts the Flex-Fuel sensor voltage into Ethanol ratio %
- Map B - Cranking Fuel multiplier adds extra fuel volume during cranking for a given coolant
- Map C - Multiplies the Fuel Volume amount (ml) for a given coolant temp
- Map D - Adds Ignition Timing for a given Ethanol amount against RPM

The DIT Custom Maps can be configured in the same way, see the Subaru BRZ tuning guide and BRZ example ROMs for more information and to copy and paste the changes across as required.

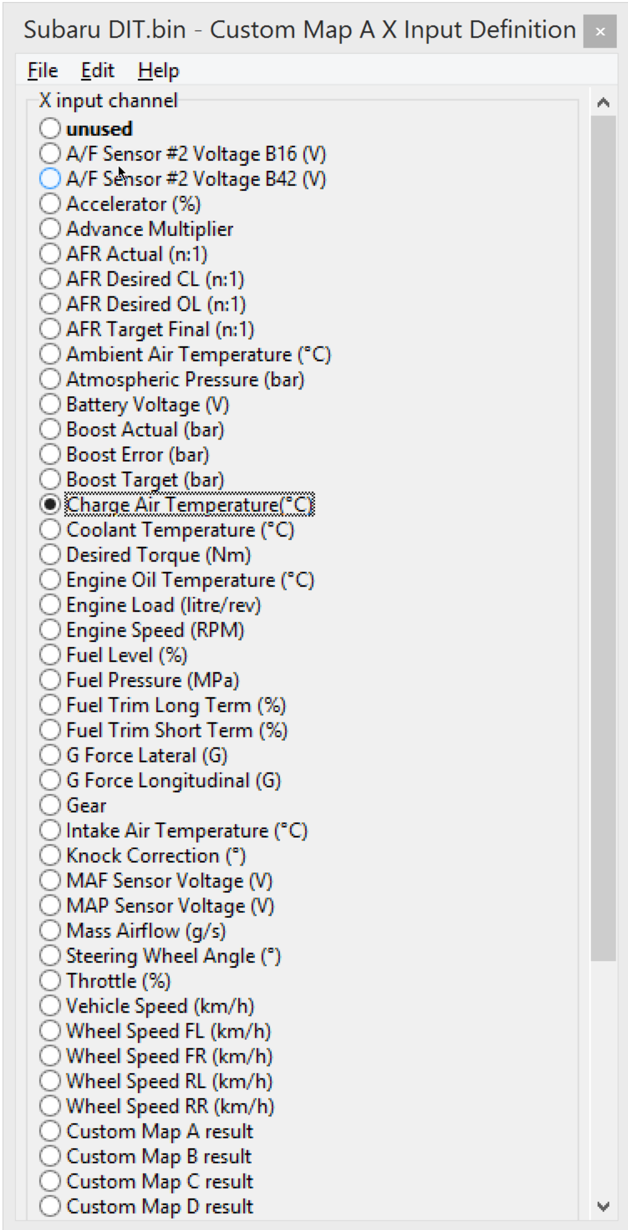
4.2.10. How to set up Fail Safe maps

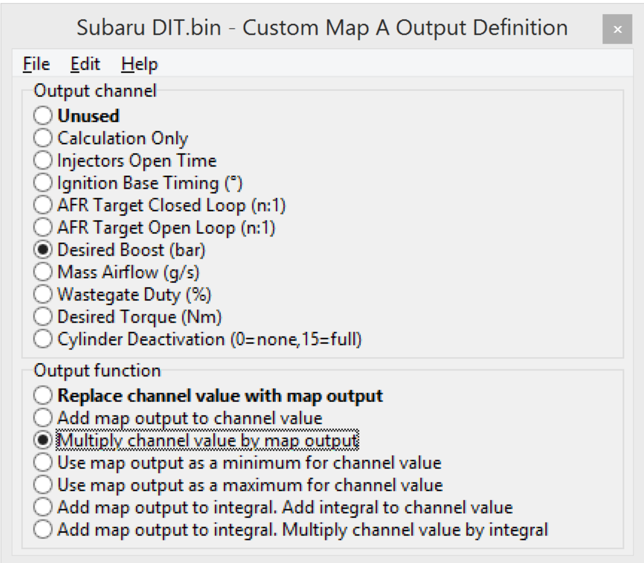
Fail Safe maps can be written to protect the engine in certain conditions.
With the many different Custom Map inputs (see the right-hand side image) you can monitor many different sensors and should a calibrated threshold be exceeded then the engine power can be reduced to protect it.

Some failsafe examples are below:

- If the engine runs lean at high load the boost pressure could be reduced.
- If Charge Air gets too high then reduce the boost pressure.
- If a temperature (Air, Coolant, Fuel or Oil) exceeds a certain level then a Torque Limiter could be enforced to protect the engine.
- EGT sensors can be imported and further protection added if EGT becomes too high.
- Torque protection per gear
- Wheel speed differential protection
- Knock Correction protecting

There are many options to protect the engine, see the dedicated Custom Maps manual for how to configure the various custom maps, it is located in ProECU under the HELP and HELP FILES tab or found here on your computer: C:\EcuTek\ProECUHelp\ProECU RaceROM Custom Maps



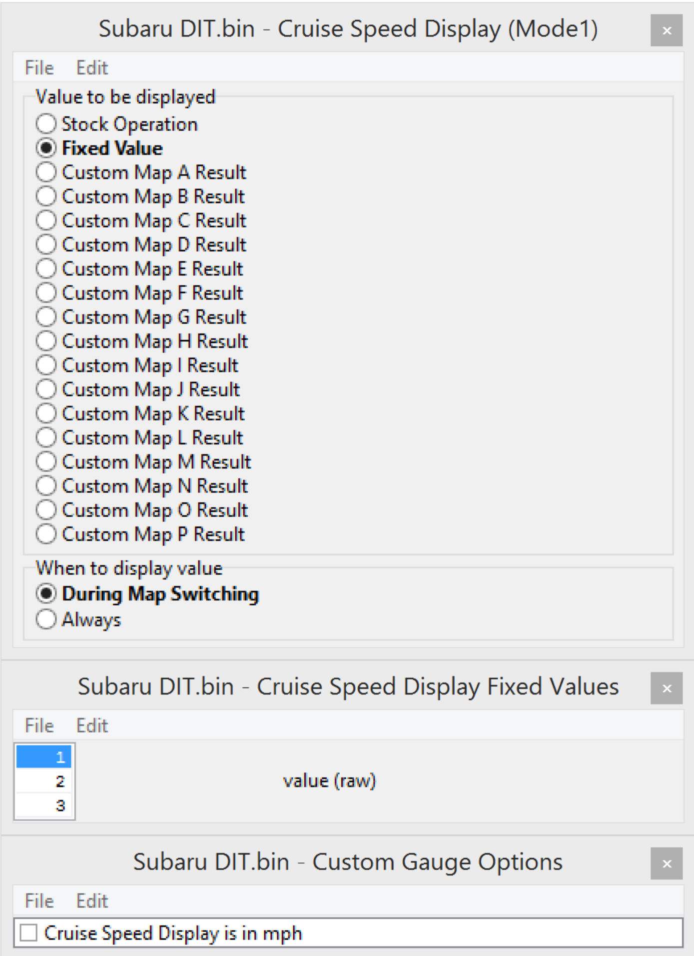


4.2.11. How to set up Gauge Hijack

The Subaru WRX and Forester XT have a MFD (Multi Function Display) in the centre of the dashboard, this displays the current boost pressure, oil temp and accel pedal position.

RaceROM Boost Controller will show the Target Boost Pressure on the MFD using a boost gauge hijack feature, this feature becomes active when the cruise control toggle switch is moved and RaceROM drives the MFD boost gauge. The Boost Target can then be adjusted and seen on the boost gauge.
This is demonstrated in a video on EcuTek website under the RaceROM Boost Controller section.
http://www.ecutek.com/Products/Trade/ProECU-Tuning-Suites/Subaru-Tuning-Suites/Subaru_DIT/RaceROM/RaceROM-Boost-Controller

The Map Switch video is also hosted on the EcuTek website shows how the Accel pedal gauge is hijacked during Map Switch mode to display the current mode selected (Mode 1 to Mode 3).
The Oil Temp gauge is also hijacked and shows a preconfigured Octane rating for each on the map switch modes (91 octane, 95 Octane and 100 Octane)
http://www.ecutek.com/Products/Trade/ProECU-Tuning-Suites/Subaru-Tuning-Suites/Subaru_DIT/RaceROM/map-switching



Using Custom Maps we can hijack the Oil Temp and Accel Pedal gauges to display something that we choose, the output or the result of a custom map, here are some examples below:

Ethanol Content Ratio by using a Flex-Fuel sensor
Charge Air Temp
Knocking amount
Ignition Timing
AFR or Lambda
Wastegate Duty
Engine Torque
EGT by using an additional sensor

Not all values can be displayed as true units and some additions or offsets are sometime required due to the displays numerical limitation.

Lambda is typically 0.7 to 1, so the Accel pedal could display 70 to 100 to indicate the current Lambda reading.

See the Custom see the dedicated Custom Maps manual for how to configure the various custom maps, it is located in ProECU under the HELP and HELP FILES tab or found here on your computer: C:\EcuTek\ProECUHelp\ProECU RaceROM Custom Maps

5. Glossary

AFM
Air Flow Meter

AFR
Air Fuel Ratio

AIT
Air Intake Temperature

CAT
Charge Air Temp

DI
Direct Injection or Direct Injector

ECT
Engine Coolant Temperature

EOI
End of Injection angle

FTST
Fuel Trim Short Term

FTLT
Fuel Trim Long Term

AIT
Intake Air Temp

MAF
Mass Air Flow (sensor)

MAP
Manifold Absolute Pressure (sensor)

MRP
Manifold Relative Pressure or boost pressure

O2 Sensor
Lambda Sensor (oxygen sensor)

SD – Speed Density
The Mass Air Flow in grams is calculated from MAP sensor not MAF sensors

SOI
Start of Injection angle

VE
Volumetric Efficiency

VVT
Variable Valve Timing