Log parameters & meaning

Original post by Russell: http://www.n54tech.com/forums/showthread.php?t=21269

RPM: Engine speed or revolutions per minute. N5x Engines have a maximum value of about 7000 rpm although maximum usable power is usually far below this maximum value.

Boost: This is the pressure, in PSI, in the charge pipe just before the throttle valve. Under ideal conditions the boost value will equal the boost set point value (see Target). The practical range of boost values is zero to about 20 psi. RPM affects the Turbos ability to generate high boost values. At low rpm (about < 2500 rpm) the exhaust flow is too low to adequately drive the compressor wheel to make high boost values. At very high RPM, the stock Turbo's run far outside of their efficiency curve and hence capacity…. limiting the amount of boost available above 5800 RPM.
The turbos ability to supply mass flow is also greatly affected by ambient air temperature and pressure (elevation). Raising either temperature or elevation decreases the mass airflow capability of the turbos.

Target: Target is the boost target or set point established by the JB4. It is generally a curve that peaks around 5500 rpm and falls off to either side of this rpm range. The various maps, pedal position, and internal logic will change the values and shape of the curve.

Typically when troubleshooting a car that is making less boost than expected you need to note whether the target is lower than expected thus resulting in less boost or if the target is appropriate but boost is falling below target. As troubleshooting for these symptoms are completely different.

In addition to the JB4 defined maps there is a map 6 available for diagnostics where the tuner can fill in the maximum boost targets by RPM under user adjustments. Although this generally is only used to make maps less powerful than what is already defined. Map 7 for example is about the highest boost targets that factory turbochargers will support. Many older cars will not be able to hit map 7 targets at higher RPM.

ECU PSI: The ECU (Engine Control Unit) is just another name for the DME (Digital Motor Electronics) or engine computer. The ECU PSI is the value of boost the ECU thinks is the current boost value. With the JB4 this signal is altered by the piggyback to meet various tuning objectives. As boost follows target ECU PSI will generally follow DME BT (DME Boost Target).

DME BT: The DME BT displays the current boost set point for the DME (ECU). The stock DME BT psi range is about 0 - 9 psi but will vary based on engine speed, load and various temperatures and pressures.
The DME BT value is read from the DME over the CANbus. The JB4 does not modify the DME BT as the value is calculated inside the DME computer. Flash Tunes, on the other hand, rewrite the tables inside the DME and generally do modify the DME BT.

IAT: Intake Air Temperature is measured in the charge pipe just before the throttle valve and can be thought of as intake manifold temperature. It is measured by the TMAP sensor (Temperature Manifold Air Pressure) combination sensor…. Both boost and temperature in one physical sensor.
Typical values for a car with the stock FMIC (Front Mount Inter Cooler), not running in boost, is 20 degrees above ambient. With the onset of a boost condition, the temperature will rise quickly as boost rises and also with the length of time of the pull. Values quickly go from the normal 20 degree rise above ambient to perhaps a 70 to 90 degree rise.
The best upgraded FMIC will start out with only a 10 degree rise when not under boost and will limit the temperature rise to only about 25 degrees over a several gear pull. Also the lower the ambient temperature is the better the outlet temperatures will be.
Meth/water injection is almost always injected prior to (upstream) of the TMAP sensor location and therefore, results in this value dropping as injection commences. With the nozzle sizes used today (CM 10, 12, 14), a typical IAT reading will drop about 30 degrees from the IAT starting value just prior to going WOT (Wide Open Throttle). IAT below ambient temperature is typical using meth/water injection.

Reading is always displayed in Degrees F and is read from the left hand scale X 10.

Pedal: Gas pedal input. This is the position of the pedal under your right foot with a range of 0-100%. While using cruise control this value will always report zero.

Throttle: Throttle blade position (0-100%). The throttle trend displays the position of the throttle in percent. The DME takes the pedal position signal (or if higher, cruise speed demand) to generate an engine load demand signal. The load demand signal is then used to index most of the internal variables in the DME.

Note that unlike a non turbo engine, the BMW boosted engine moves the throttle demand open much quicker than the pedal position demand and uses boost control to determine overall load and power above minimum power levels. Note: Corrective actions such as loss of traction control action or ECU PSI over DME BT or very low HPFP pressure can all cause the throttle to close…..without user input.

PWM: Stands for pulse width modulation but is also known as wastegate duty cycle. Represents the demand for the boost signal going to the vacuum control solenoid(s). The larger the signal the more vacuum is applied to the WG (Waste Gate…. exhaust gas bypass valve) control actuator and the harder the WG plug is forced onto the WG seat. The system is designed to "fail" in the WG open position so that the engine is not subjected to high boost conditions under a failure condition, such as a broken wire or faulty output.
PWM does not actually control the WG position.... but rather the pressure ratio across the exhaust gas power turbine. The WG position actuator has a very weak spring in it and yet controls a WG plug with a large pressure drop across it at high engine rpms and boost levels.

At low to moderate WG demand signals, the vacuum applied to the WG actuator will totally close the WG plug. As rpm and boost build, at some point, the pressure drop across the WG plug will overcome the supplied vacuum force of the actuator and the WG plug will reopen, maintaining the established exhaust gas pressure ratio.... and indirectly, also the boost pressure ratio, with no further action by the DME.
At high WG demand signal levels, the WG demand signal is great enough to maintain the WG plug on the WG seat, ensuring all gas flow passes though the power turbine.

During turbo spool up the JB4 will allow 100% PWM but under boost the cap is set to 86%.

FF: Short for "feed forward" or the fixed component of the PID boost control system. This is the starting point for boost control and the PID will then adjust PWM above or below this value as needed for fine tuning. The user adjustment variable FF / wastegate adaptation value (0 -150) scales the FF value and will adjust itself over time as part of the normal
JB4 learning routines.

DutyC: Dutycycle. This represents the DME's requested duty cycle.
Which is the DME version of the JB4s PWM signal. Since the DME is no longer controlling boost this value has no meaning but is sometimes useful for diagnostics when troubleshooting boost issues that were not present before the JB4 was installed.

Ign1: Ignition Advance is the number of crank degrees BTDC (Before Top Dead Center) when the spark is turned on to ignite the fuel/air mixture in the cylinder. Generally higher engine loads/boost levels require less advance because the burning process progresses faster (less time to complete) under higher cylinder pressures. Higher engine rpm generally requires more ignition advance because there is less time for the cylinder pressure to build up before the piston starts it’s downward stroke. The displayed ignition advance value if for cylinder #1 but the DME can adjust timing on a cylinder by cylinder basis using an advanced knock sensor system with long term (octane detection) and short term (knock detection) trims analogous to a fuel trims. The displayed values can change a large amount under light to moderate loads….. more than 30 degrees on some engines. WOT (Wide Open Throttle) will result in a much narrower range of values….. usually dish shaped with values in the 10 to 13 degree range over the ends of the rpm band and a minimum valley value of about 6 - 8 degrees.

Of more importance is watching out for sharp drops of more than 3 degrees in the engine high torque/power band…. typically in the > 4500 rpm range. Sharp drops of 3 degrees from one scan to the next indicate potential knock activity and are a general indication that the boost curve may be set too high for the available octane. Drops randomly throughout runs especially on pump grade fuels are expected but repeated drops in the same gear indicate an overly aggressive tune.
Also note the DME will raise and lower advance as a function of normal mapping like during traction control events, gear changes, etc, and such drops are completely normal.

The JB4 uses this activity and the overall value of the ignition curve to calculate the Avg Ign (Average Ignition Retard) value.

Avg Ign: Average Ignition Retard. A JB4 calculated value with a range of 0 - 6 that represents the average amount of timing below the maximum possible curve over a short term window. Lower values indicate a higher overall ignition advance while higher values indicate a lower overall ignition curve. This calculation is used by the JB4 for evaluating octane content by both map 5 (auto learning) and map 3 (methanol injection). Values below about 1.5 result in full Map 3 or Map 5 scheduled boost levels.
Values between about 1.5 and 6.0 result in lower and lower boost targets as an added safety feature for these two maps. As a general rule when using meth, race gas, or heavy E85 mixtures look for values below 2.0. When using pump gas expect values of 5 or higher.

FuelEn: Fuel enrichment is a trend of the relative positive bias applied to the pre *** wideband O2 sensors. This bias allows the JB4 to effectively change the air/fuel ratio target. A higher bias means a richer targeted air/fuel ratio. And the DME will generally hit its air/fuel target provided the fuel trims are within range.

The amount of O2 bias applied can be adjusted by changing the "All Map AFR" table values under the "User Adjustment" Tab. Higher table values at a given rpm point will lower the AFR and richen up the mixture.

Note: The JB4 assumes this function will only be used on a factory flash. If using an aftermarket DME flash such as the JB4 back end flash this feature should be disabled by setting all values to 0 to avoid an overly rich condition.

Trims: Fuel trims (0-50). The Trims display shows what the STFT (Short Term Fuel Trim) signal is doing. Note this is only logged in N54 G5 ISO. N55 does not show fuel trims and instead has a meaningless parameter here. Values range from 0 up to 50 and unlike some of the other displayed values, the left hand scale range (Y value) must be set to 50 to see the entire range of this variable. A trim value of 50 means that the DME is adding 134% extra fuel..... while a trim value of 0 means that the DME is only supplying 92% of the normal fuel demand. An indicated value of 8 means that the DME is supplying its normally programed amount of fuel.
The Y scale range can be set by going to the "Settings" Tab and changing the "X Scale 0 - 100" value. Note…. I know……. the Y scale value is adjusted by changing the X scale variable…. It is not a big deal…..only the difference between a boy or a girl.

This signal can be quite variable but as long as it does not spend too much time pegged at 50 (maximum value) then all is well. If pinned at 50 for long parts of a run typically AFR will behind to lean out and tuning adjustments must be made to get fuel trims back within range.

This signal is used to calculate an automatically tuned variable FOL (Fuel Open Loop) or just OL (Open Loop) variable. See OL discussed later.

Meth: Methanol flow (0-100%). The meth display shows a voltage conversion of the JB4 0-5v #15 input. Typically this input is connected to a BMS supplied FSB system which is used by the JB4 to control the methanol pump and measure pump pressure and flow. This signal can also be read from a stand alone 0-5V flow sensor such as the one provided by Aquamist.

When using map 3 the JB4 will transition between a low and a high boost map as a function of "meth" and "avg ign". If using map 6 the
JB4 will add the "Meth Boost Additive" to the map 6 values as a function of "meth" and "avg ign".

The user defined "Meth Flow Scaling" represents the minimum amount of flow to be considered "full flow". In the case of the FSB this value is 60. If methanol flow is half of the full flow value then the JB4 will target half way between its low and high map.

The field "Meth Boost Additive" determines how much boost the high map runs. With a maximum value of 80 representing approximately 20psi.
Typically for pump gas operation a value of 40 should be used here (approx 17psi) while for race gas and/or E85 mixtures values of 60-80 are more appropriate. It is unlikely factory turbos will be able to hit targets higher than 65 so those are generally used only for aftermarket turbos.

AFR: The AFR (Air Fuel Ratio in Lbs air/ Lbs gasoline fuel) trend displays the higher (leaner of the two banks of three cylinders.... cylinders 1>3 or cylinders 4>6. Typical values are 15:1 at light engine loads decreasing to around 12.5:1 under heavy engine loads and high rpm.
Note: It is normal to have the AFR display 20:1 when car is coasting in gear or under a heave misfiring condition as the DME will cut off fuel to either the misfiring cylinder(s) or all cylinders if coasting.

FP L: Fuel pressure, low system. Pressure is read on the left hand scale X 10. Note this parameter is only logable in N54 G5 ISO. No other system logs this. Other systems will show oil temp in this location. Otherwise known as the in tank low pressure fuel pump. This value typically ranges from 55-70psi. If dropping below 50psi it indicates a problem with your low fuel pressure pump. Most often that problem is it needs to be augmented with an inline pump to keep up with the higher fuel demands required by ethanol usage.

FP H: Fuel pressure, high system. Otherwise known as the high pressure pump. Note all N54 include this and N55 can only log this if also equipped with the flex fuel connector. This value represents the voltage of the high pressure 0-5V sensor, where a value of 20 is 5v. Each unit of measure is roughly equal to 150psi. Typical values at full throttle are 10-14, or 1500 to 2100psi. Values of less than 900psi as full throttle indicate a fuel delivery problem and the JB4 will failsafe at 700psi at full throttle. Note when not at full throttle a typical value is 5 or 750psi.

Map: The currently selected map. Refer to the JB4 map guide for additional details. You can use the drop down menu to change maps here.

Gear: Currently selected gear. For manuals 0 means the car is out of gear or the clutch is depressed.

CPS: Short for "crank position sensor offset". This represents the number of degrees of offset being currently applied to the crank position sensor. Which is roughly equivalent to timing retard. Given the adaptive nature of the DME this feature is not often used unless directed by BMS technical support.

Clock: An internal JB4 variable used to keep track of various internal loops such as PID evaluations or ADC conversions. The value has no meaning to anyone other than BMS.

FOL: FOL is a bias applied to the HPFP pressure signal that the DME reads to affect the actual HPFP pressure. Higher values of this variable makes the DME see a lower HPFP reading and thus the DME actually raises the true HPFP pressure. If the HPFP or LPFP is weak or the E85 mixture is too high and the FOL value is also high….. typically above 85……. the DME could see a low HPFP pressure and generate a code.

FOL is an autotuning variable based on the TRIMS signal. The FOL value will trend up if during pulls the TRIMS signal is at maximum. Conversely, if the TRIMS signal is staying at zero, the FOL value will trend down.
The autotuning range of the FOL signal is 40 to 100. The maximum range is 0 to 100.

Also read/copy this for information on FU(x) functions and remember to get the latest version (For the software you are actually running) as these functions can change as time goes on. These Notes are specific to each software version so remember to get a copy when you update your specific firmware. The following reference if for the N54 ISO software version 27.8.

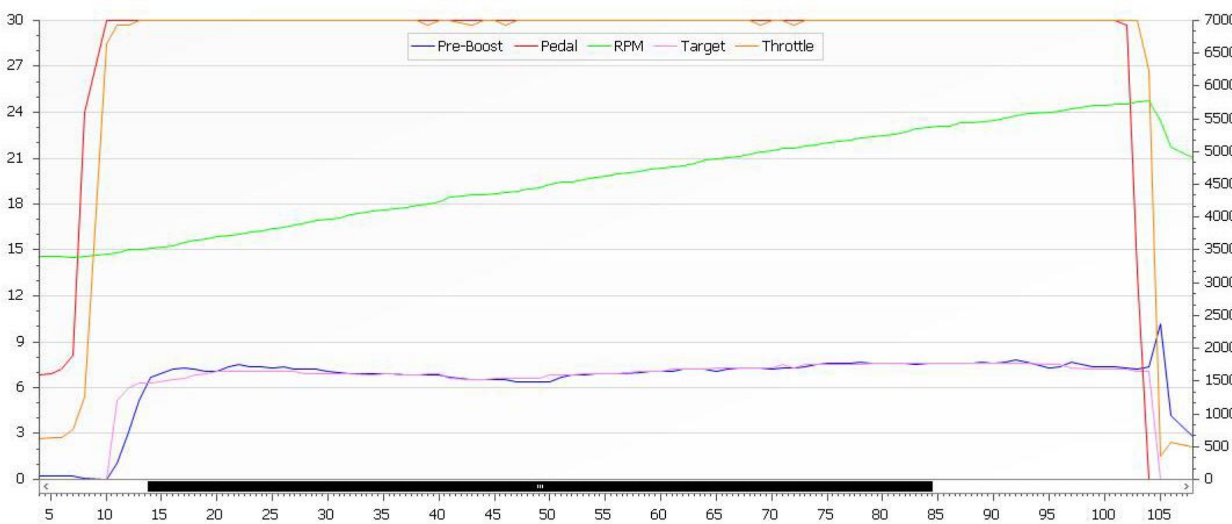
http://www.n54tech.com/forums/attach...7&d=1385010727

Below you will find a series of JPG Logs describing what is normal/typical for various displayed variables. Later I hope to add some of the "typical" abnormal ones also.

You will note that I like to view the logs with a 30 unit range on the left vertical axis.
This scale range fits very well with all variables except the TRIMS value which needs to be view on a 0 - 50 range scale.
The vertical axis range can be modified under the "Settings" Tab "X" Scale 0 - 100.

Map 0 comment
This style of display will be the starting point for all my comments and examples. It includes: PRE BOOST, PEDDAL, RPM, TARGET & THROTTLE.
As other trend variables are addressed....they will be added as well.
This trend is actually a map 4 log but I'm using it to display the OEM DME stock boost target and boost levels. If you copy and then open the Map 0 Stock.csv file, and then add the ECU PSI & DME BT trends...notice how all boost setpoints and boost values line up.

Note: A Flashed DME will not have these same boost values.



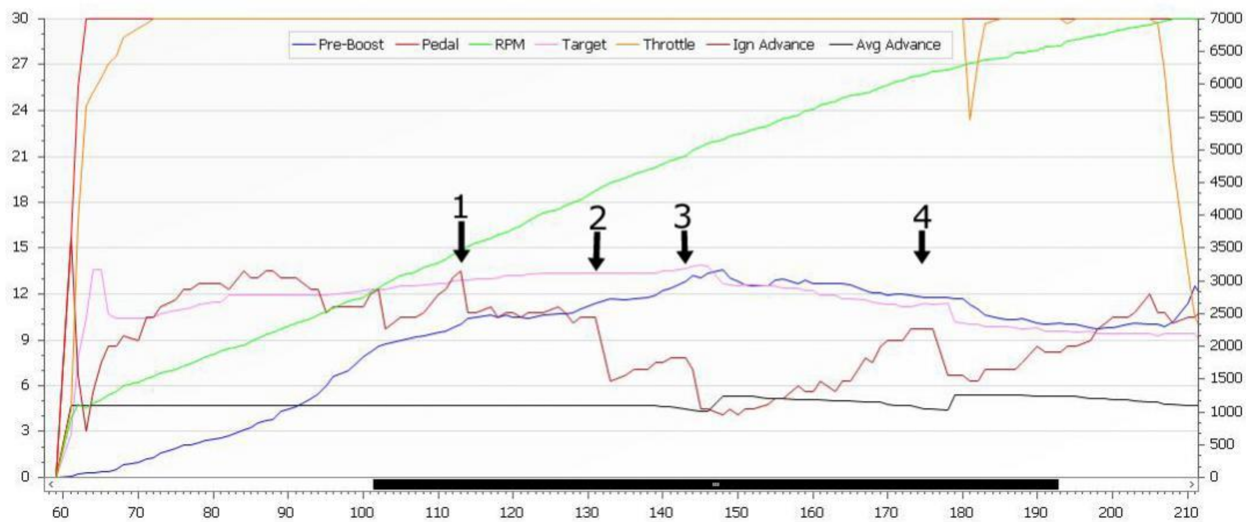
Map 1 comment
This Log displays the typical boost curve for Map 1. Notice how low the RPM is when the run begins.... about 2200 RPM. Starting this low in RPM allow a good assessment of how quickly boost should build up as RPM rises. In this case about 11 psi by 3000 rpm. Cars with DP's, however, will tend to build boost much faster than those without DP's. Small changes in the starting conditions like RPM or pedal position, just before going WOT... can greatly affect the rate of boost rise also.

Map 5 + AFR + Ign Adv This Map 5 Log shows a typical Ignition Advance and AFR curve. The AFR goes slightly high initially on tip in as boost starts to build. By 3500 RPM the AFR is back down to 14 and continues to lower as RPM continue to climb. By about 5800 rpm the AFR has flattened out at a value of about 12.5. Also note how the AFR goes to 20 after the run.

The Ign Adv curve is also normal with the typical dish shape. Generally at low RPM the timing is >10 degrees... decreasing to around 6 degrees during engine maximum VE operation (4000-5000) rpm and then climbing to 11 degrees at 6800 rpm.

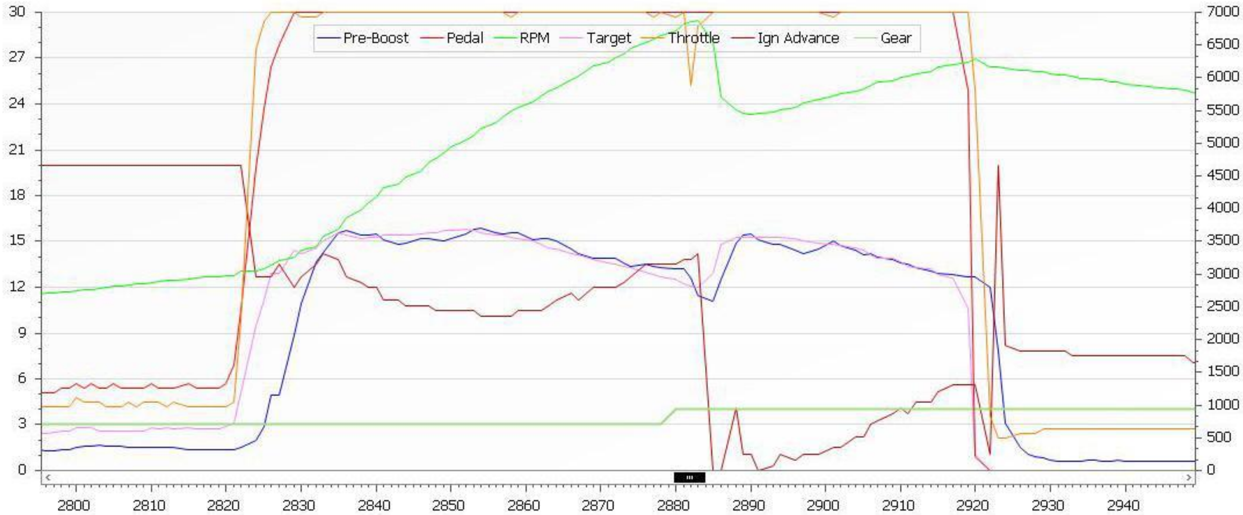
Map 5 + Ign Adv + Avg Ign
This Map 5 log is the same as the above log but shows how the Avg Ign function learns based on good timing. The Avg Ign value starts the run at about a value of about 3. The Ign Adv drops about 3 degrees just under 4000 rpm, but this does not trigger a reduction in the Avg Ign value because lower timing, when approaching maximum VE (Volumetric Efficiency), is expected.
Later as both rpm and Ign Adv climb, the Avg Ign value slowly learns down, allowing slightly more boost.

Map 5 Ign + De-Tuning (Also note the poor rate of boost buildup... (finally 13 psi at 5000 rpm)
In this log we again see the Ign Adv and Avg Ign curves. The Avg Ign value starts out at a value of about 5. At Ignition events marked #1 and #2 the timing drops but the Avg Ign value is constant because of the engine rpm range.
Note, however, that following event #2 the overall timing was high enough to allow the Avg Ign value to start trending down.
At event #3, another sudden drop in timing occurred, with a corresponding fast rise in Avg Ign and drop in Boost setpoint.
At event #4, same thing happened, but this time the drop in boost setpoint generated a larger boost deviation from setpoint, temporarily closing the throttle a small amount.

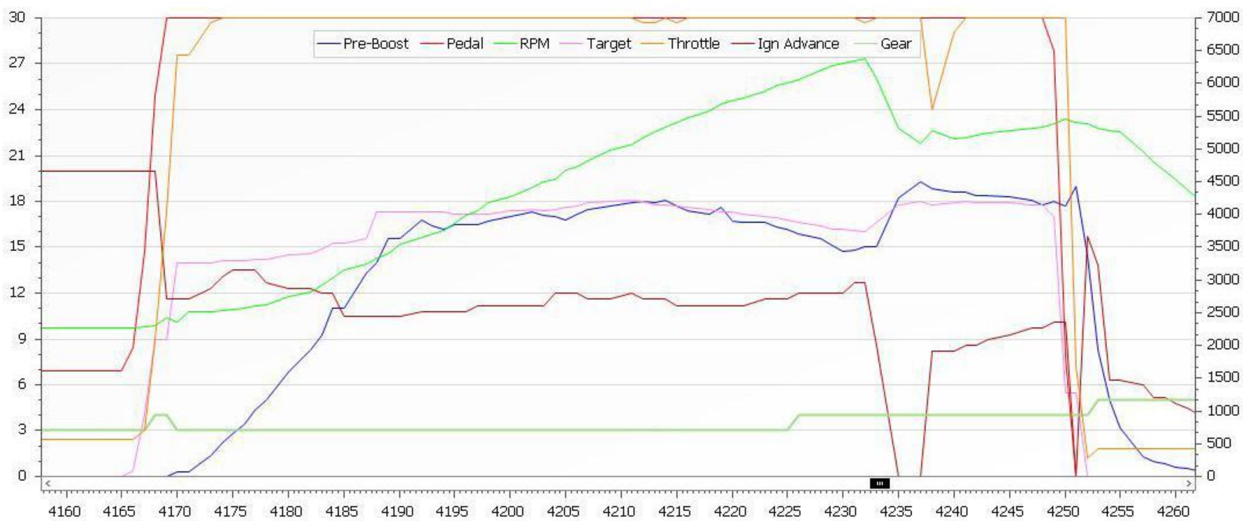


Map 3 Flat Line Timing.
In this log you see a good example of "Flat Line" timing. Flat Line timing does not refer to a perfectly flat timing line over the rpm band.
It refers to the ignition timing.... following an up shift .... not returning to the previous ignition value at the same rpm.
In this example we see the typical dish shaped ignition curve......14 degrees @ 3500 rpm, decreasing to 10 degrees @ 5500 rpm and increasing again to 14 degrees at 6900 rpm.

Following the up shift into 4th gear, the timing is not nearly as good. Instead of 10 degrees at 5500 rpm now we only have < 1 degree.
As the rpm climbs in 4th gear, the timing never recovers to the previous gear's value. It has flat lined along the bottom of the chart.

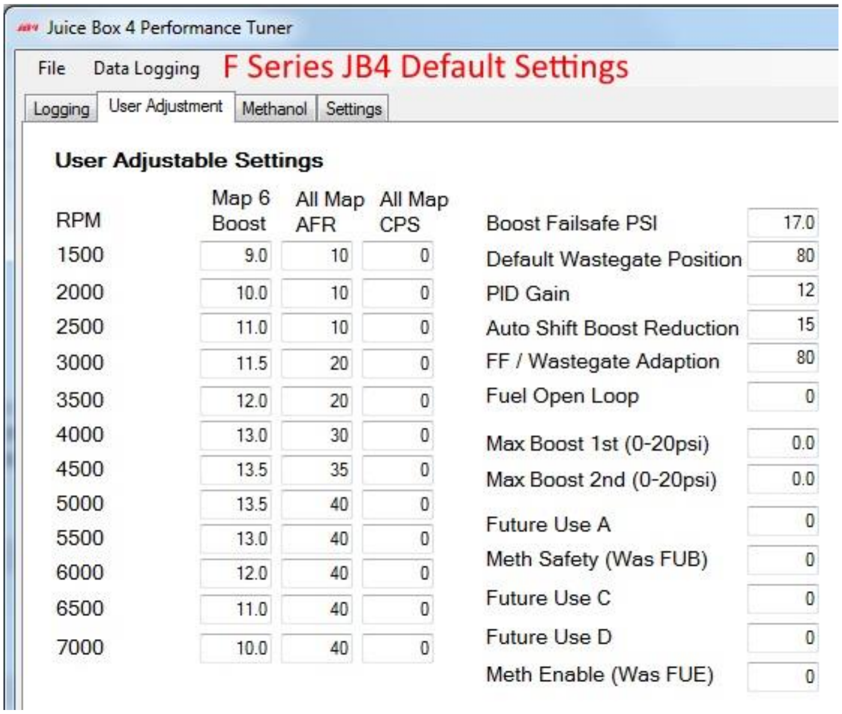


Map 3 Better Flat Line Timing.
In this log you can see where the Flat Line timing issue is almost completely resolved.
Overall timing is slightly lower than in the above example but the boost is about 3 psi higher.
The dish shape is gone and has been replaced with a slowly rising ignition curve with rpm.
Following the up shift into 4th gear the timing immediately recovers to a value of 8 degrees.
At the same rpm in 3rd gear (5000 rpm) the timing was about 11.5 degrees.... So the loss of timing was less than 4 degrees on the up shift and the loss steadily falls from that value as rpm climb.
By 5300 rpm the timing is back to within one degree of the previous gear's value



Default settings

Integrated



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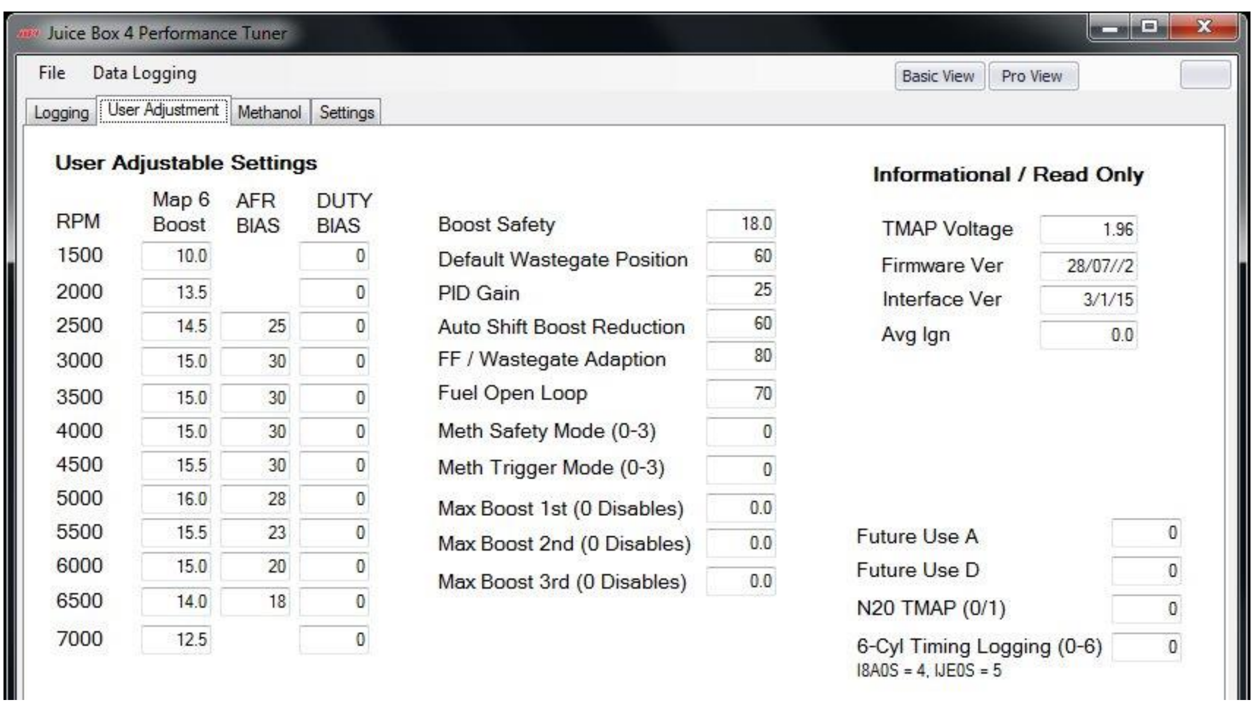


Duty Bias

Original post by Terry http://www.n54tech.com/forums/showthread.php?t=29893

Do not change the Duty Bias values from the default of '0' unless instructed to do so, or if logs indicate that they need adjustment

Hey guys,

This thread is to discuss the basics of the new JB4 v28.8 "duty bias" tuning parameters, and general adjustment of the JB4's boost control PID system. Tuners and "shade tree" tuners who like to evaluate their logs and tinker may find this information useful. If you are not a tuner then ignore this thread. This information is not intended for casual enthusiasts.

Variables we'll be discussing:

PWM: duty cycle output to the boost solenoids. 0% means the solenoid is fully open while 100% means the solenoid is fully closed.

FF Curve: The base PWM curve before the PID output is added in. We've programmed this curve within the JB4 as a function of boost target, pedal input, RPM, EGT, and some other smaller criteria.

FF User Adjustable: A 0-150% variable that globally scales the FF curve up or down across the board. The JB4 adjusts this value on its own via its wastegate adaption process.

FUD=99 User Adjustable: This setting disables the wastegate adaption learning process which is sometimes useful when trying to simplify variables while tuning.

PID Gain: Represents the gain value of the PID system or roughly how far away from the FF Curve PWM is allowed to go. Note that I and D are represented as a function of P so changing this value rescales all of the PID variables in a linear fashion.

Duty Bias: The new user adjustment fields which allow adjustment of the FF Curve by RPM.

A simplified formula for ultimate output PWM is:

FF Curve = Internal Mapping * duty bias/50 * FF/100
PID Output = boost_error (boost vs. boost target) * Internal Mapping * PID Gain
PWM = FF Curve + PID Output

So using these variables for any given boost curve you can rescale the FF curve and rescale how far away from that FF curve the output PWM is allowed to wander.

In the following posts I'm going to walk you through some more specific examples of these variables in play.

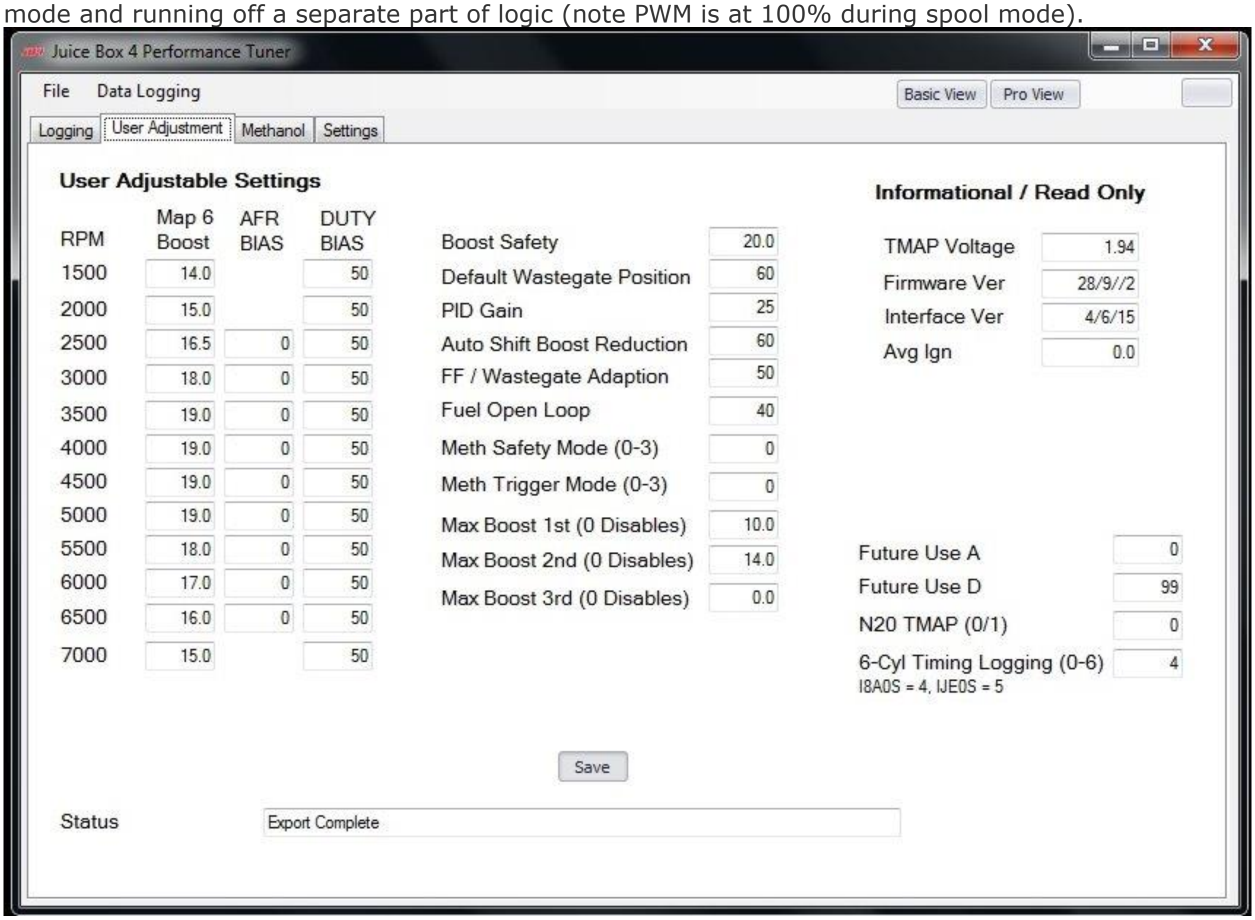
For this series of examples we're going to be using the same map6 boost curve shown here. I'll be changing some basic variables to show their impact on the PWM output and boost behavior.

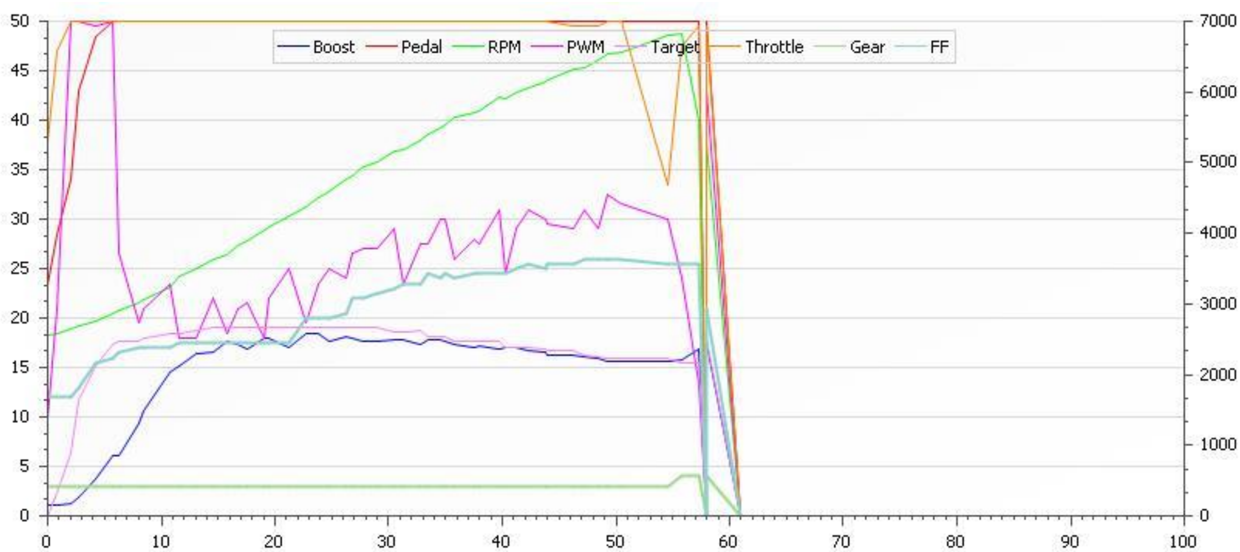
For starters I've disabled wastegate adaption and hard coded FF at 50, duty bias at each RPM at 50, so we can get a baseline curve.

The most ideal situation is one where FF and PWM closely match with only minimal PID values added in to the output. This will result in faster boost targeting and smoother overall operation.

In this log note the relationship between boost, target, FF, and PWM. Boost is slightly below target with these settings and as a result the PID values have gone higher, pushing PWM above the base FF curve. PWM itself has some ossification as minor changes in boost multiplied by a relatively larger PID Gain value introduce a mild oscillation effect.

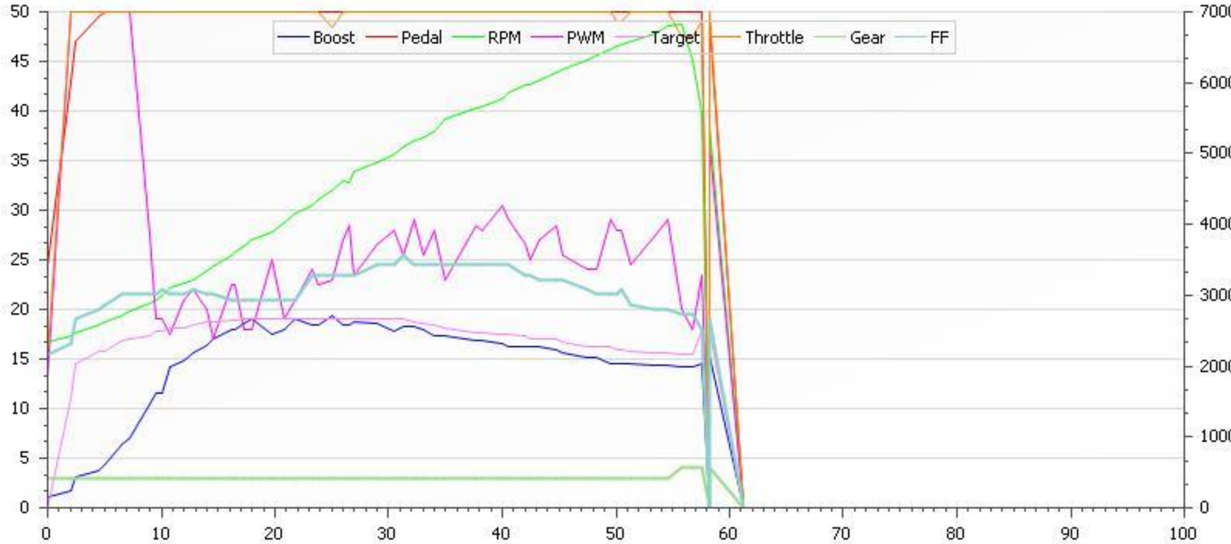
Also note that it's only useful to compare PWM and FF during relatively "steady state" situations where the turbo is spooled up and the trans locked in gear. Prior to sample point 12 the turbo is in spool mode and running off a separate part of logic (note PWM is at 100% during spool mode).

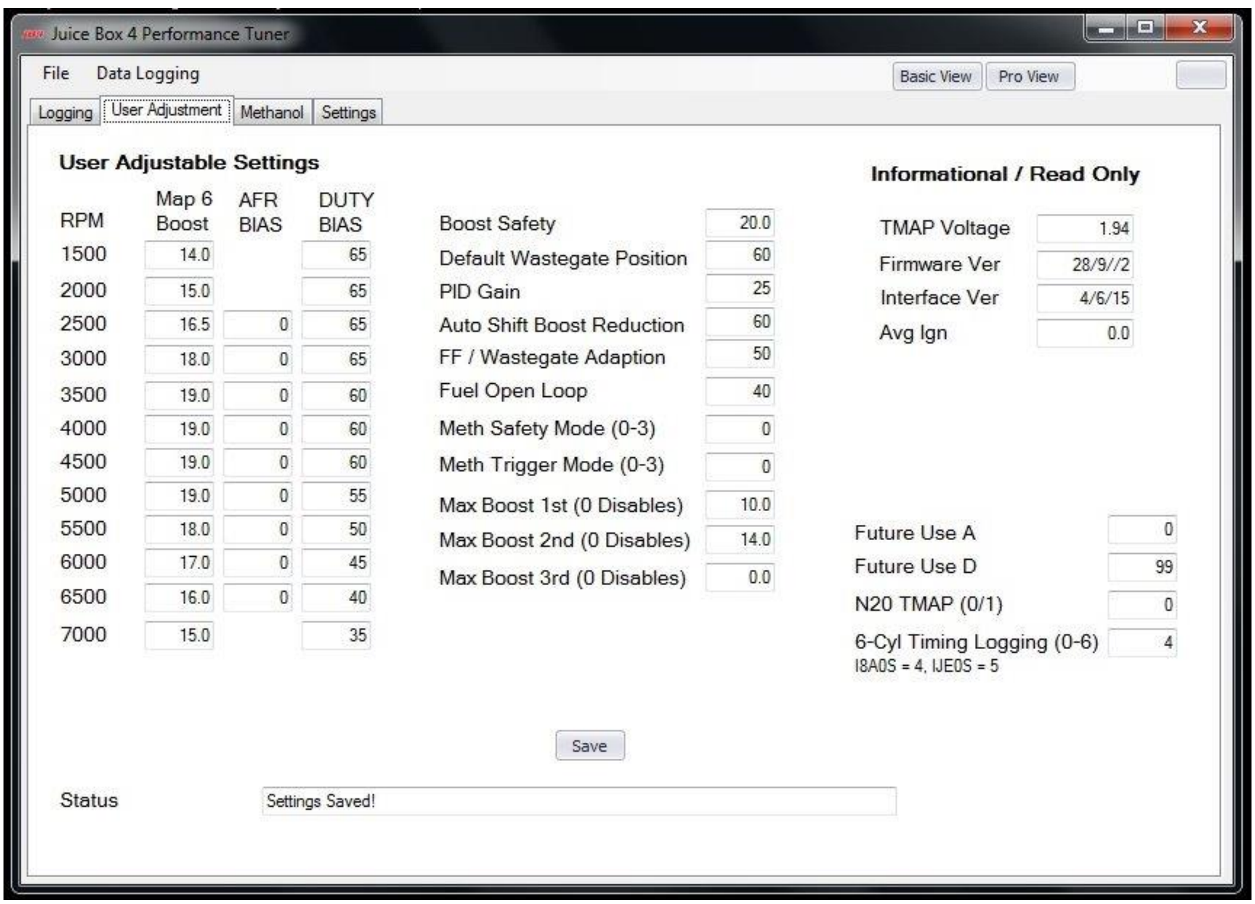




Next I modified the RPM based duty bias values to reshape the FF curve in a way I thought might better match the PWM output. Note all other variables have been kept the same.

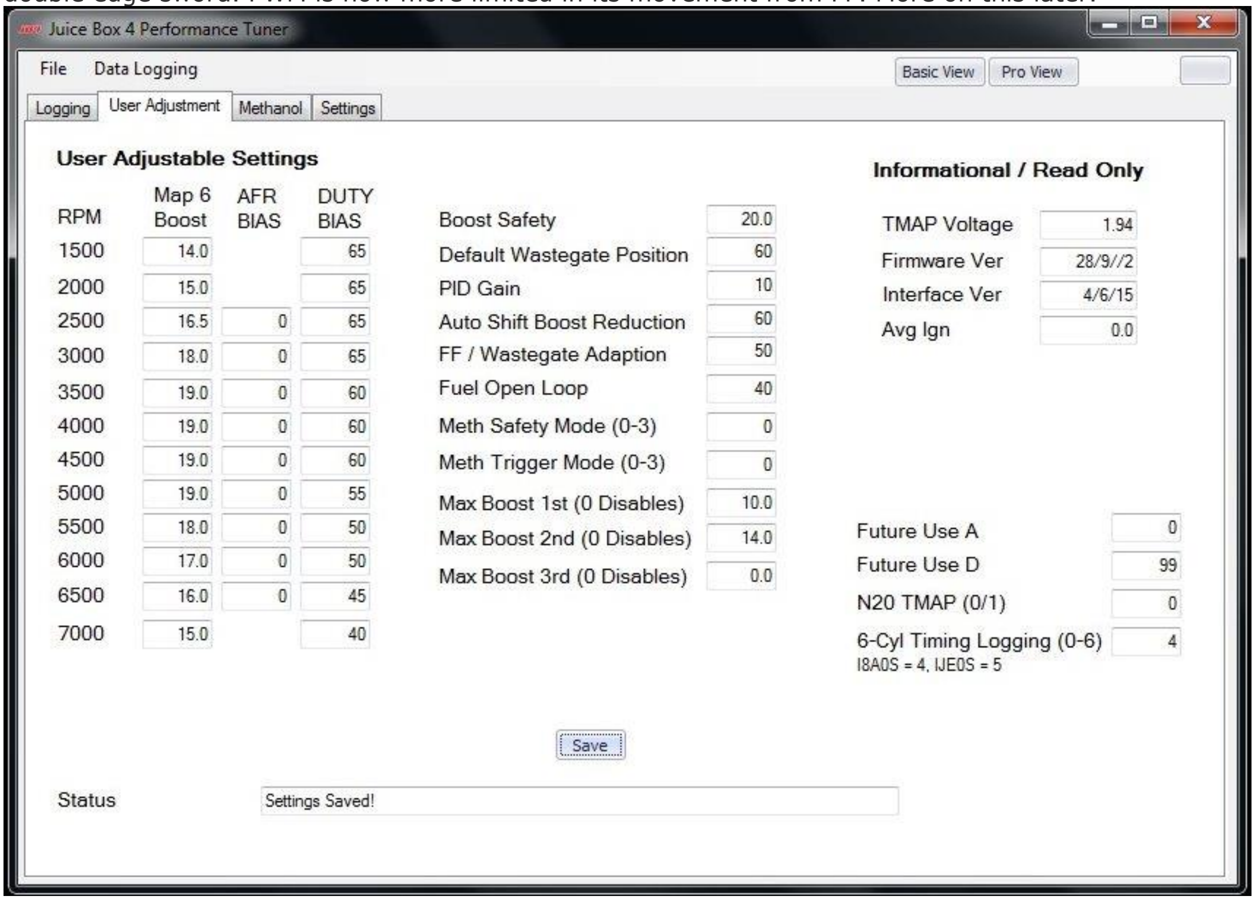
You can see the net effect of this change in the resulting log. PWM is closer to FF down low, but looks like I lowered FF too much up top as there is still some separation.

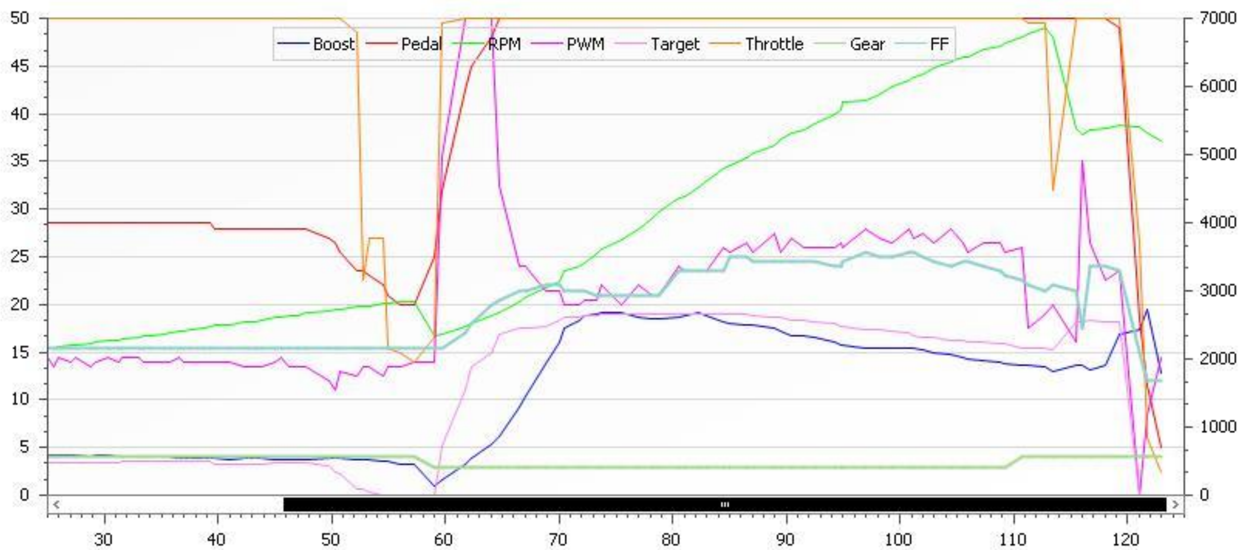




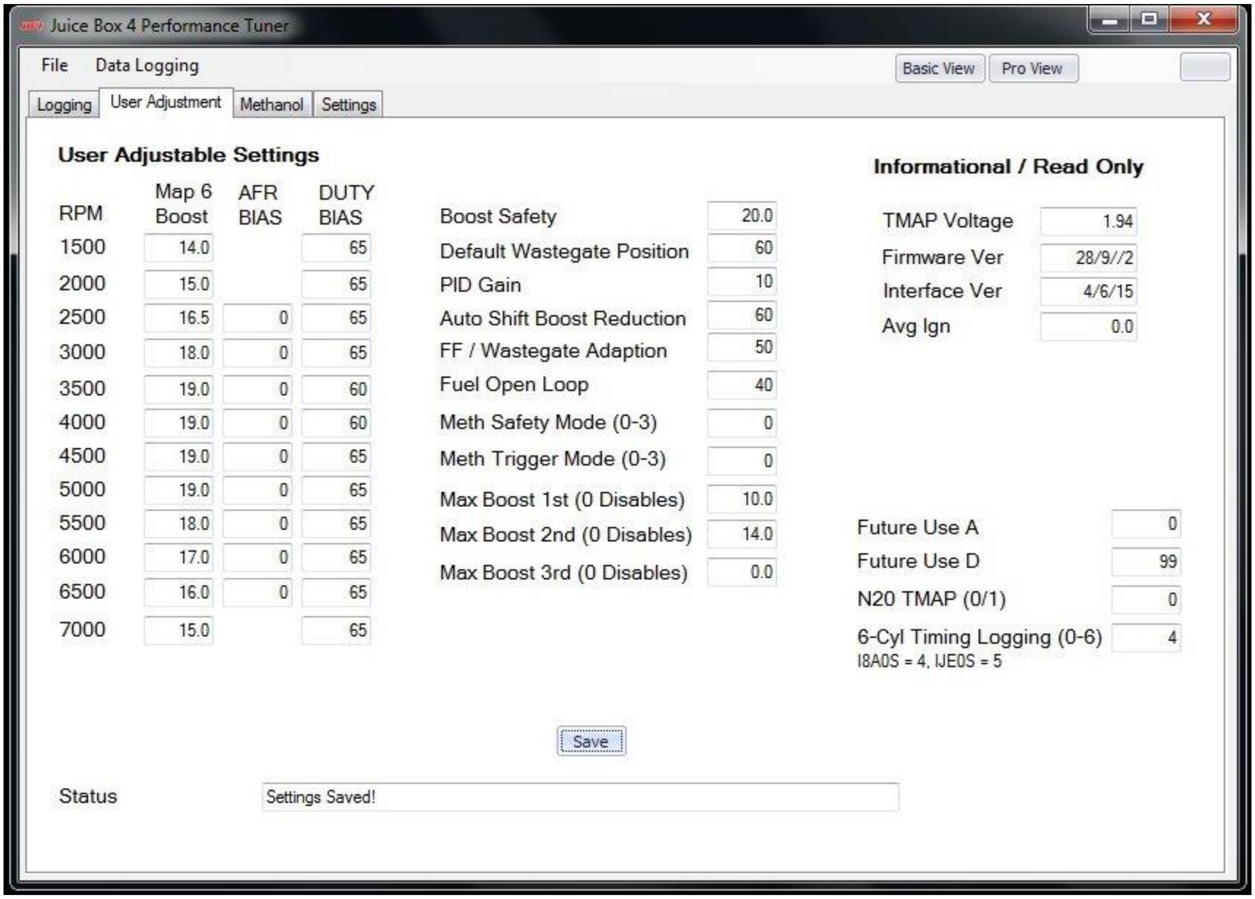
I raised up FF at higher RPM.

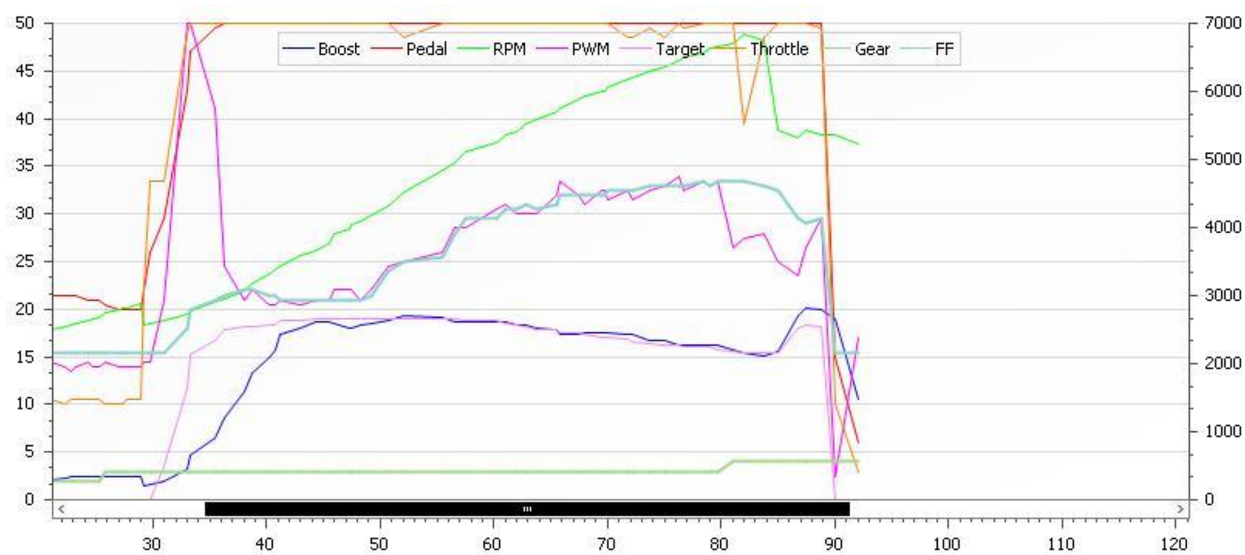
In addition I lowered PID Gain from 25 to 10. This is a rather drastic change but I wanted to show what effect this would have on the output. Note that there is no longer PWM oscillation. But this is a double edge sword. PWM is now more limited in its movement from FF. More on this later.





FF is still well below PWM up top and we're under target. So I've raised up duty bias further in those areas. This looks to be a pretty good match now.



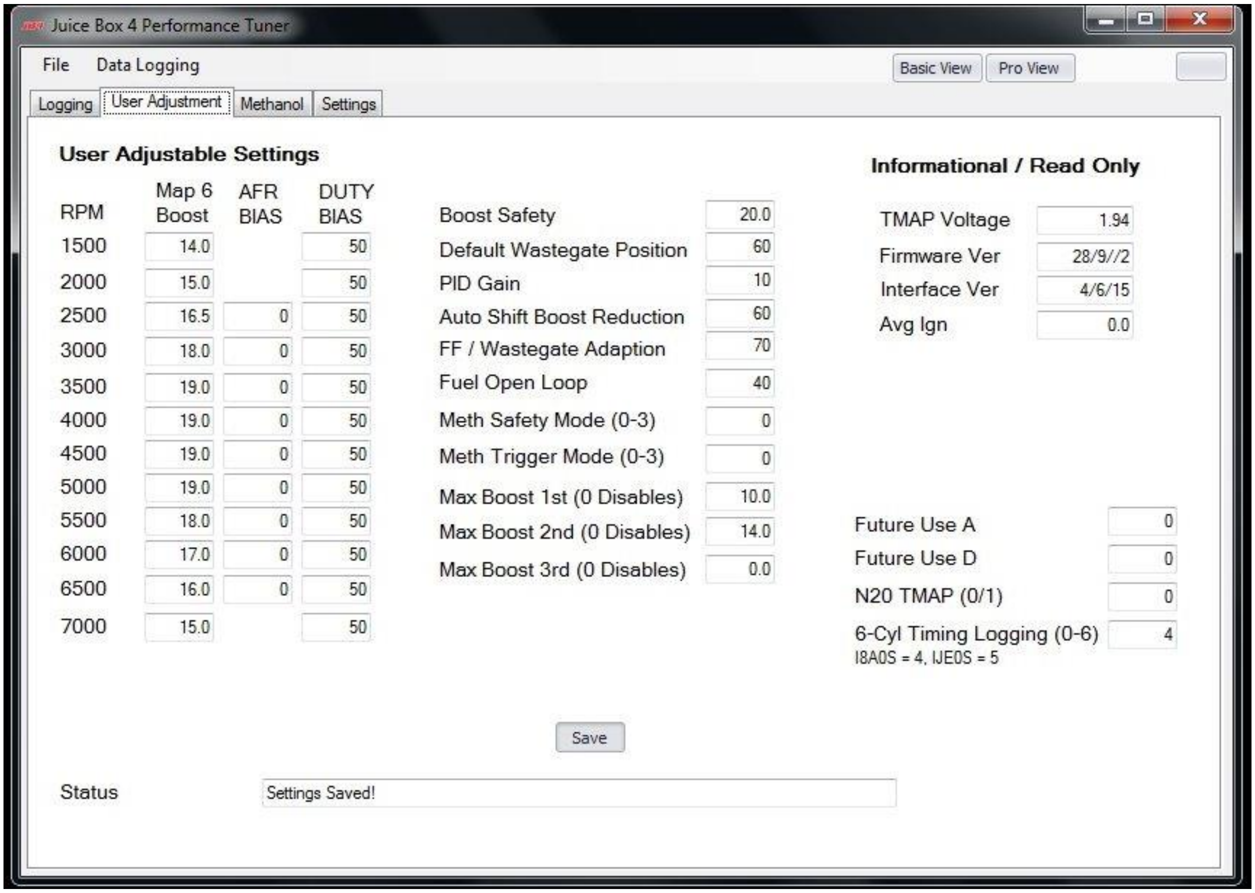


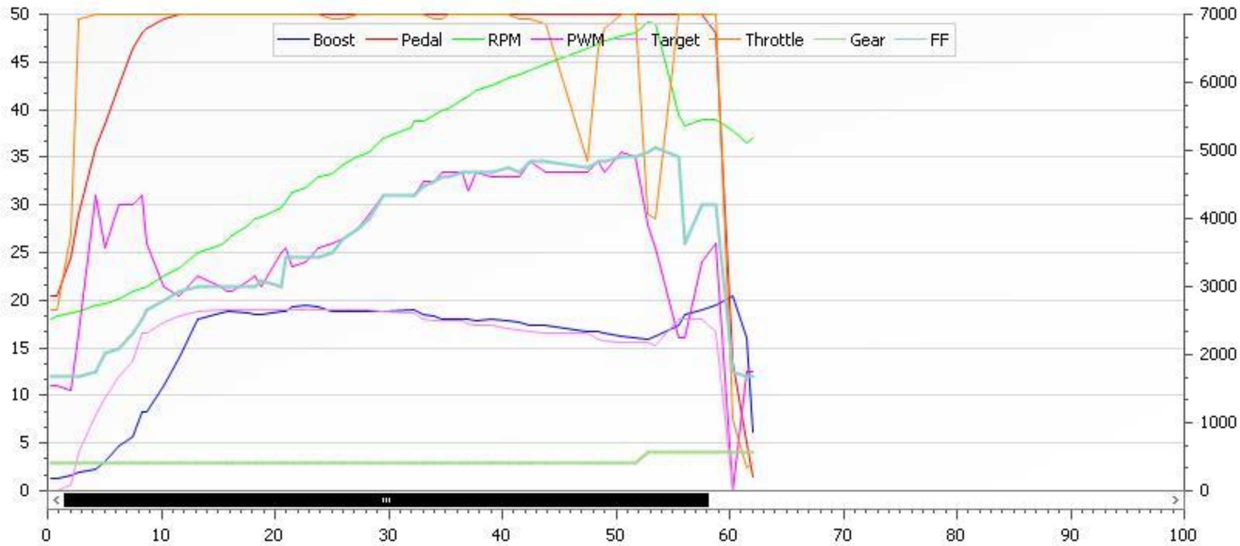
You'll notice that the duty bias is roughly the same at all RPM points now. This means the JB4s internal curve is a pretty good fit. You'll remember there are two variables to scale the output. FF to scale it globally, and duty bias to scale it by RPM. So I've reset duty bias all back to 50 (effectively disabling this variable), set FF to 70 which is a little higher than the 50 we started with where FF was below PWM across the board, and put FUD back to 0 to enable wastegate adaption.

With wastegate adaption on the JB4 will raise FF if the FF Curve is below PWM and will lower it if the

FF Curve is above PWM.

I did 2-3 runs like this and by the 3rd run FF had learned up to 85 and PWM & FF were pretty closely matched with minimal PWM oscillation.



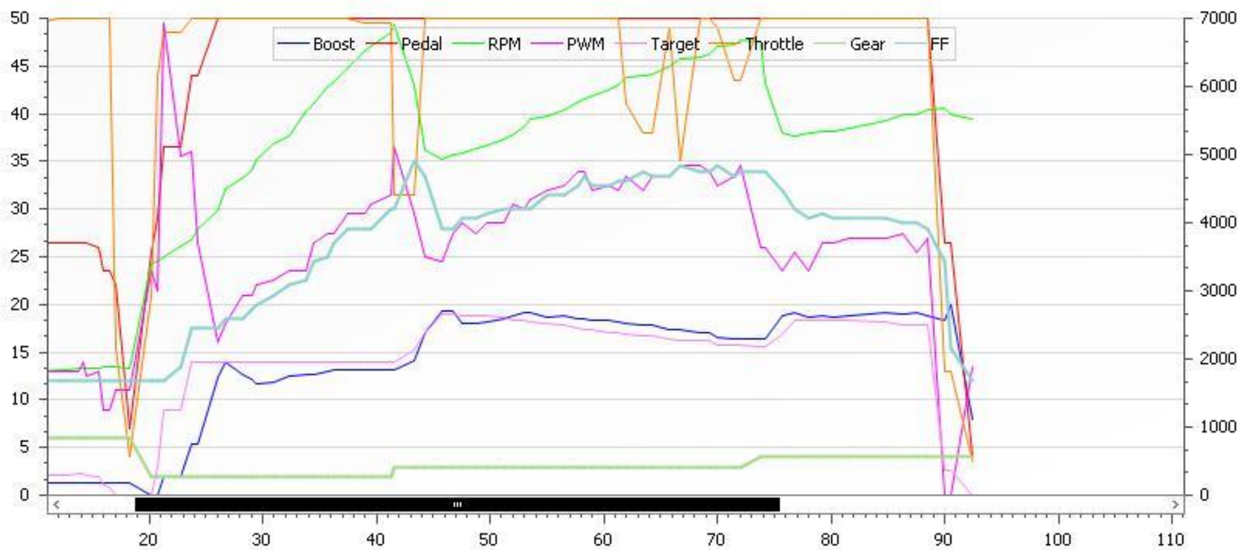


It's important to remember that single gear FF tuning can only take you so far. The PID component is required to adjust for dynamic situations like throttle transitions, gear shifts, varying short term conditions like EGT and inlet temps, etc.

With PID Gain set to 10 while I've smoothed out PWM I've also limited it's response range. In this example the low PID Gain is preventing PWM from moving far enough below FF to keep boost under target.

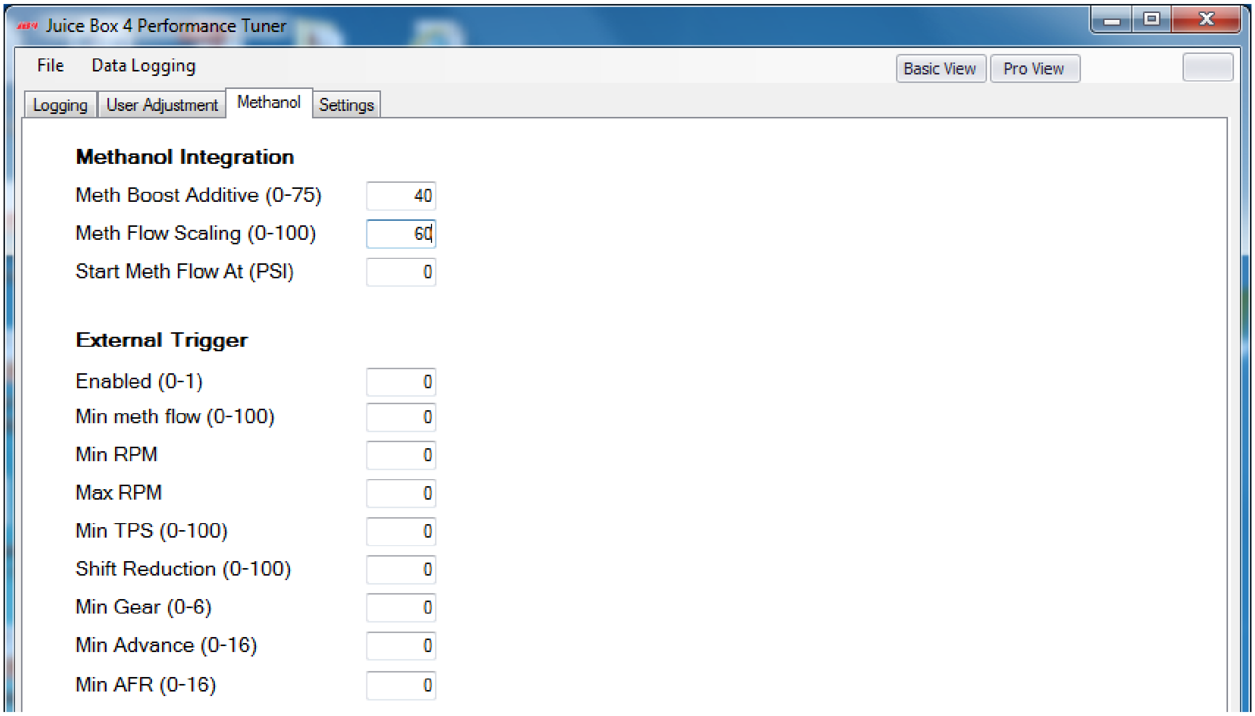
Note the FF system is also at work here slowly reducing FF during this run. It started at 85 and finished around 80. A slightly higher PID Gain value of maybe 15 would allow more PID response while still limiting PWM oscillation.

Unfortunately I ran out of time today and wasn't able to do any additional logs. But hopefully this thread gives you an idea for the basics here.



Meth

Meth enable default setting.



Boost Additive is added on top of map1 (13psi max). 40 is 4.0psi added etc.

Meth is flowing default on map 3, 6 and 7

Meth Safety Mode:

0 - Raise boost as a function of meth flow & historic timing (default)
1 - Raise boost as a function of meth flow only
2 - Start at high boost target and reduce IF flow drops below flow level for 1 second under boost.
3 - Start at high boost target and disable all safety systems. Meth flow is completely ignored.

Meth Trigger Mode:

0 - Meth flows on maps 3, 6, and 7 (default operation)
1 - Meth flows on all maps
2 - Meth flows on map 3 only
3 - Meth is disabled on all maps