The Quick Guide To Subaru Tuning with the UTEC Part Deux

The Ginge's UTEC tuning experience

As of 2007

Updates

- 09/07/2003 – Initial Version
- 02/26/2004 – Added information on 4.1 firmware release
- 03/14/2007 – Update based on 5.8 firmware release
  - General Clean up
  - Includes tuning with the new Speed Density mode

Agenda

- UTEC Overview
- UTEC and knock
- Map Tuning
  - Fuel – 0% tuning and Open Loop Fueling
  - Fuel tuning with Speed Density mode
  - Timing, Boost, Parameters
- Logging
- Third party UTEC GUI
- Spare Solenoid Usage

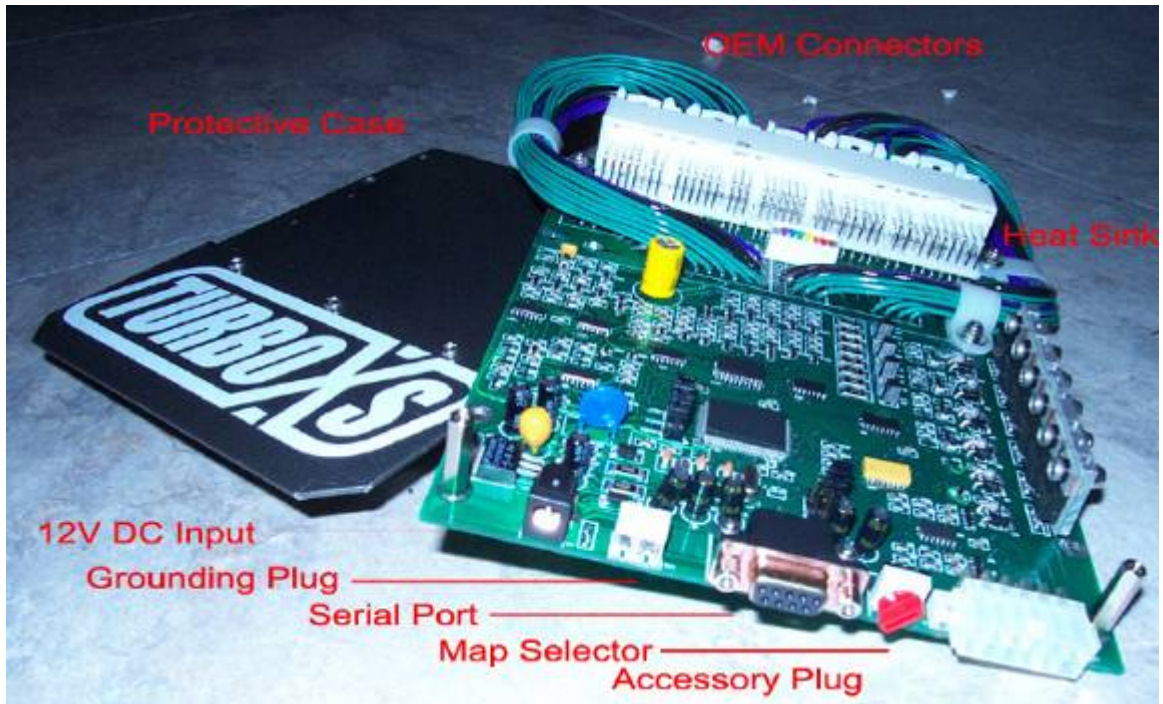
The UTEC

User **T**unable **E**ngine **C**omputer

The UTEC is not a piggyback! Past crossover it has 100% control of fuel, timing and boost

Override control of:

- Fueling
- Timing
- Boost



Expectations

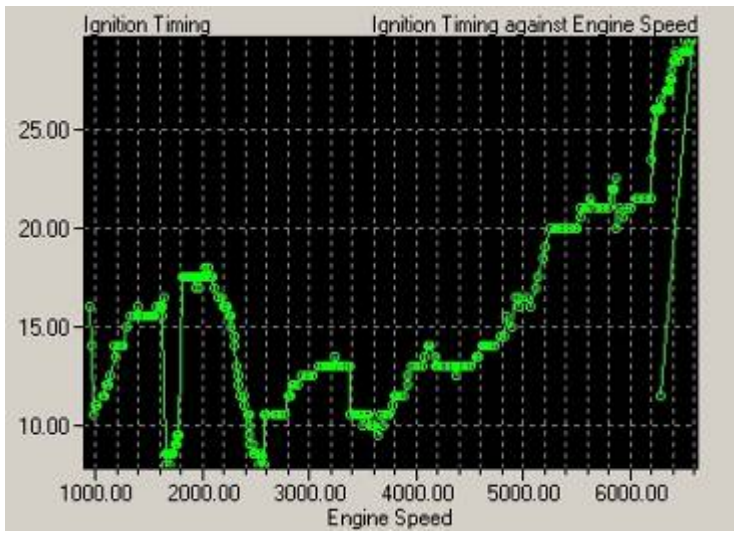
- What you are going to learn
  - ✓ The basics required to tune with the UTEC
- What you are NOT going to learn
  - Real WRX/STi tuning!
- Caution: This will be enough information to destroy your WRX!
- ** READ THE UTEC USER MANUAL **
  - This quick guide does not replace it

READ THE UTEC USERS MANUAL

Just in case you did not read the last bullet on the previous page

UTEC Overview

- How does the UTEC enable more Horse Power?
  - It doesn't! BOOST = POWER, TIMING = POWER, FUEL = POWER, the UTEC just enables you to correctly tune for boost and aftermarket parts



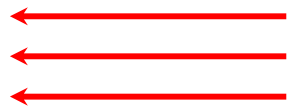
UTEC and Knock

- UTEC only corrects knock when it is in control of timing:
  - TPS > Crossover Or when Speed Density Crossover has been met
- Timing retarded by default 2 degrees for 100 crank cycles
  - Continues to retard timing until knock is no longer detected
- Default setting are very sensitive
  - Which is a good thing unless you have a noisy built block

New Knock Settings

- Found Under Parameters -> Knock Constants
- Automated knock timing retard is NEW
  - This is the amount of timing that is automatically taken off the whole timing map after knock is detected.
    - Automatic retard values are lost once the car is switched off

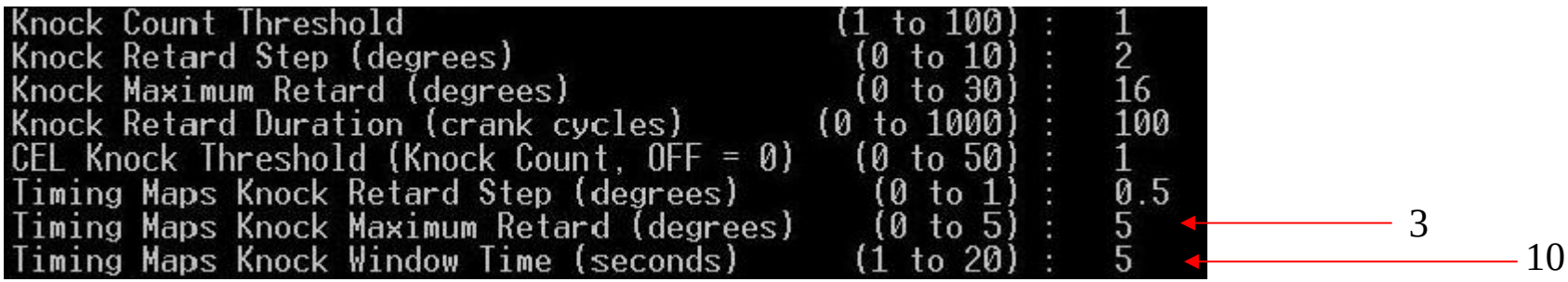
Knock Count Threshold	(1 to 100) :	1
Knock Retard Step (degrees)	(0 to 10) :	2
Knock Maximum Retard (degrees)	(0 to 30) :	16
Knock Retard Duration (crank cycles)	(0 to 1000) :	100
CEL Knock Threshold (Knock Count, OFF = 0)	(0 to 50) :	1
Timing Maps Knock Retard Step (degrees)	(0 to 1) :	0.5
Timing Maps Knock Maximum Retard (degrees)	(0 to 5) :	5
Timing Maps Knock Window Time (seconds)	(1 to 20) :	5



New

New Knock Settings Continued

- Remember if you are getting knock over and over again, TUNE your map
- Max Retard IMO is a little too big (5), if the UTEC has to take out that much timing you're in big trouble -> Set it at 3
- Raise the window to 10, this is the time between auto corrections



Map Tuning

Fuel

Timing

Boost

Parameters

Choose the fueling mode

- The UTEC supports 3 modes of fueling
  - Classic MAF offset (Don’t use this mode)
    - Fueling based on MAF offset – Fools ECU to adding/subtracting fuel at give load
  - Open Loop Fueling (OLF) (Default mode)
    - UTEC generated MAF based fueling. Past crossover UTEC has 100% control of injector duty cycle based on MAF/MAP/RPM voltage
  - Speed Density (Way cool)
    - Fueling based on volumetric efficiency of engine, past crossover UTEC has 100% control of injector duty cycle based on MAP/RPM

Fuel Tuning

Information applicable to classic MAF modification in 3.1 and 4.1 mode, Open Loop Fueling and Speed Density mode

MAP Load Point (MLP)

- The UTEC only uses TPS while below the programmed crossover (except for the boost map which is TPS based)
  - Greater than crossover and the map load is based on boost (MAP)

In this example TPS crossover is set to 35%

1973	-5.1	2.0	18	00	00	+38.2	56.1	ECU.	+0.0	ECU.	2.1	14.37
2062	-4.3	2.3	32	00	00	+29.4	9.8	ECU.	+0.0	ECU.	2.4	14.33
2060	-2.8	2.4	55	10	00	+26.2	9.1	ECU.	+4.5	ECU.	2.4	14.45
1975	-1.6	2.3	61	10	00	+22.0	9.4	ECU.	+3.6	ECU.	2.5	14.74
1980	-0.2	2.3	90	10	00	+22.0	11.2	ECU.	+4.0	ECU.	2.5	14.49
1977	+0.6	2.3	101	10	00	+22.0	11.0	ECU.	+3.6	ECU.	2.5	14.18

Past crossover the MLP can be viewed in UTEC logger #1
Remember MLP is based on actual boost pressure - MAP

Know your MAP based load points

- Settings found in SPECIAL CONSTANTS menu
  - Defined as
    - Min PSI (0 default)
    - Max PSI (18 default)

Load Column	Min PSI Default	Max PSI Default
10%	0.0	2.0
20%	2.0	4.0
30%	4.0	6.0
40%	6.0	8.0
50%	8.0	10.0
60%	10.0	12.0
70%	12.0	14.0
80%	14.0	16.0
90%	16.0	18.0
100%	18.0	18+

Modify Max PSI setting to your desired PSI

Setting the MAX MAP

- MAX Mapping must be set BEFORE you continue to tune.
  - Caution: Stock MAP sensor only reads up to ~23.3 psi
    - DO NOT SET MAX MAP Higher than this while using the stock MAP sensor

Stage Setup Guidelines	MAP MAX PSI
Stock WRX / Stage 2	18
Stage 4 WRX	20
Stock STi / Stage 2	18
Stage 4 STi (Green/Red/GT Turbo)	22
Stage 4 STi with aftermarket MAP	30

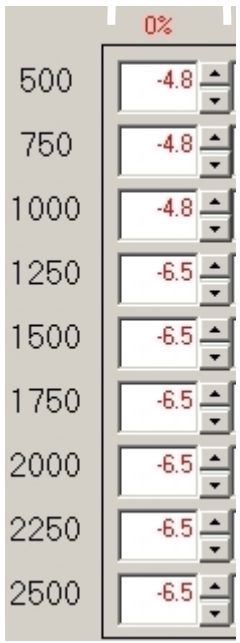
Caution When Fuel Tuning

If in doubt go RICH
(But not too rich as that will cause misfire)

- Stock O2 sensor is Narrow-wideband but it's not recommended to tune against it under WOT
  - Do not use the WOT AFR reading to tune!
  - Even when UTEC log reads rich, AFR maybe as high as 12.5:1 (Far too lean without water injection)
- Lean AFR's lead to high EGT's and possible engine damage
- Tune fuel using a real wideband O2 sensor

Tuning the 0% column for NON-stock injectors

0% column applies to all RPM's below TPS crossover

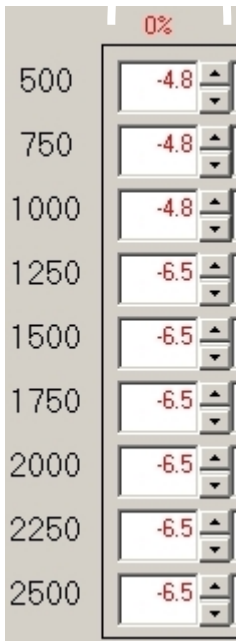


Do This First

- If you have larger than stock injectors you should tune your 0% column using an OBDII Scanner
- Effects ECU's Long Term and Short Term trim values
  - Typical Stage4 map yields LT values from +20 to –20%
  - Fine to be within –7% to +7% (I think that -7% to 0 is better)
- This is not required if you're still using the stock injectors
- Add/remove a percentage of MAF to get the trims in line.

Tuning the 0% column for NON-stock injectors – OLF / SD Mode

0% column applies to all RPM's below TPS crossover



Do This First

- When using open loop fueling or SD mode the UTEC automatically does 0% fueling compensation.
- The value used is calculated from the difference between the Stock injector size and the UTEC injector size
- The larger the difference the more modification is done.
- Follow the attached notes to work out how to really do it.
- In SD mode the injector latency also effects the 0%

Tuning the 0% column – Simple Tuning Procedure #1

- Warm the car up
- Reset the ECU
- While in neutral
  - Rev car from idle to 5000+ RPM while logging LT and ST
    - Adjust 0% to add/remove fuel where needed
      - If LT and ST show positive, ADD fuel
      - If LT and ST show negative, REMOVE fuel
  - Reset ECU and Repeat
    - Do this until LT and ST read close to 0

Tuning the 0% column – Simple Tuning Procedure #2

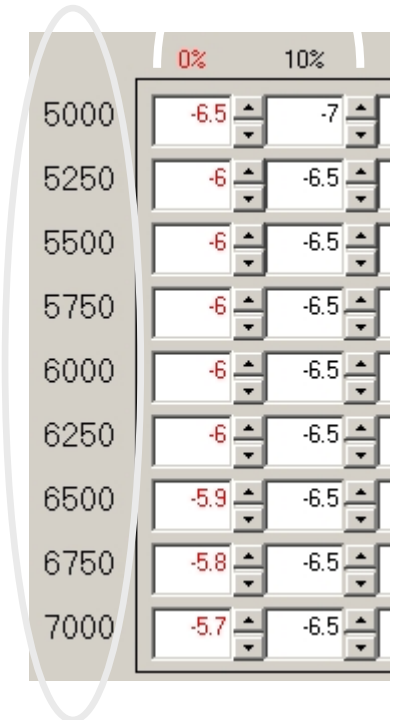
- Go drive the car while logging LT and ST
  - Under load fuel conditions are different
- Again adjust 0% column to try and get LT and ST as close to 0 as possible
  - It’s never going to be perfect, but it should be close

TIP: At Idle force ECU to be removing fuel. Idle seems to run smoother

Delta Dash Log of 0% Tune

Knock after shift (fuel correction)

Add some fuel in these areas to minimize knock after shift



- Knock after shift is usually down to two things
  - #1 Lean conditions just after shift
  - #2 Large jump in timing just after shift
    - See knock after shift timing correction
- Adding fuel at 5000+ RPM's in the lower boost range can minimize this effect
- Having timing values down in the lower columns also helps

Fuel Tuning

OPEN LOOP FUELING Mode

Why Open Loop Fueling

- Eliminates the delay in transitioning from closed to open loop fuel control in the stock ECU.
  - Big issue with the 2004+ WRX ECU.
- Enables Programmable Rev limit
- Enables injector scaling
  - Eases fuel tuning when larger than stock injectors are installed
  - Do not use scaling with a classic style fuel map.

What is Open Loop Fueling?

UTEC MAF BASED FUELING

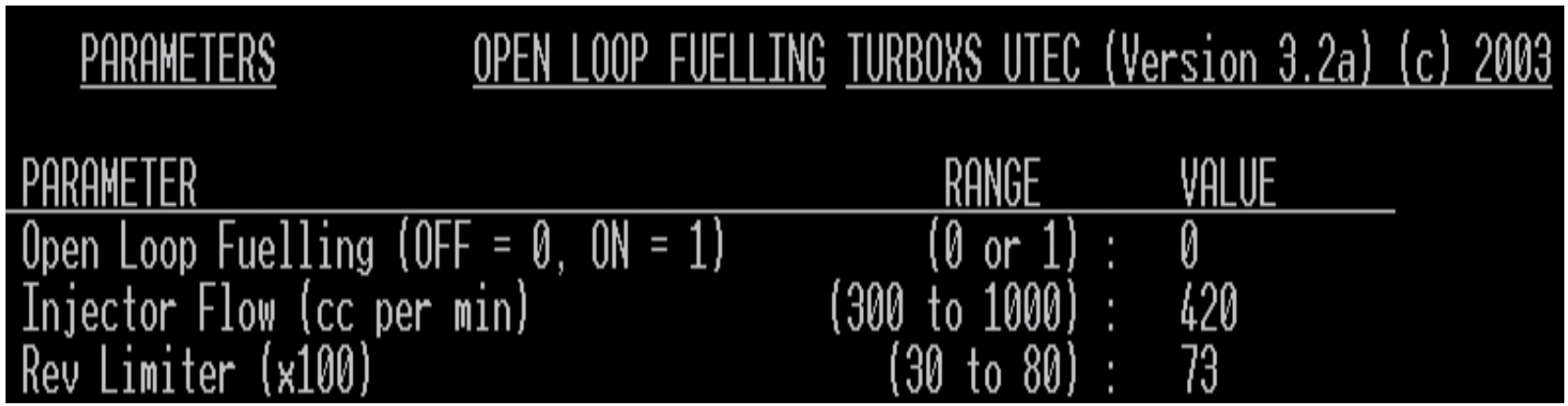
Full fuel control UTEC is 100% in control of fueling past crossover

CONSITENT FUELING, no more long term trim offset

- MAF base fueling
- UTEC calculates injector duty cycle based on MAF/RPM 
- UTEC is in full control of fueling

Turning on Open Loop Fueling

- Requires 4.1 or above firmware
  - To enable:
    - Enter the Open Loop Fueling menu option
    - Turn on Open Loop Fueling. Change to be 1
      - On by default in 4.2c and above
      - New base maps from TurboXS are tuned for OLF



Screen parameters may have changed a little since this screen shot was taken

Changing Injector Flow Scaling

- Requires 4.1 or above firmware
  - To enable:
    - Enter the OLF menu option
    - Modify Injector Flow:
      - Supports 300 to 1000 flow rate

UTEC generates AFR curve based on MAF/RPM and scaling factor

PARAMETER (RESET UTEC AFTER CHANGING)	RANGE	VALUE
Open Loop Fuelling (OFF = 0, ON = 1)	(0 or 1) :	1
Injector Flow (cc per min)	(300 to 1000) :	550
Stock Injector Flow (cc per min)	(300 to 1000) :	550
Rev Limiter (x100) (USE WITH CAUTION!!!)	(50 to 90) :	65
Open Loop TPS Threshold (%)	(0 to 100) :	25
Overboost Fuel Cut (psi)	(0 to 40) :	22
OLF indicator on Spare Sol. (NO = 0, YES = 1)	(0 or 1) :	0
Closed to Open Loop Delay	(0 to 5) :	2
Open to Closed Loop Delay	(0 to 2) :	0
MAP threshold hysteresis (psi)	(1 to 5) :	2
MAP threshold (psi)	(-15 to 15) :	-9
RPM threshold (rpm)	(10 to 50) :	17

Actual Size of injectors installed

Size the ECU thinks the injectors are

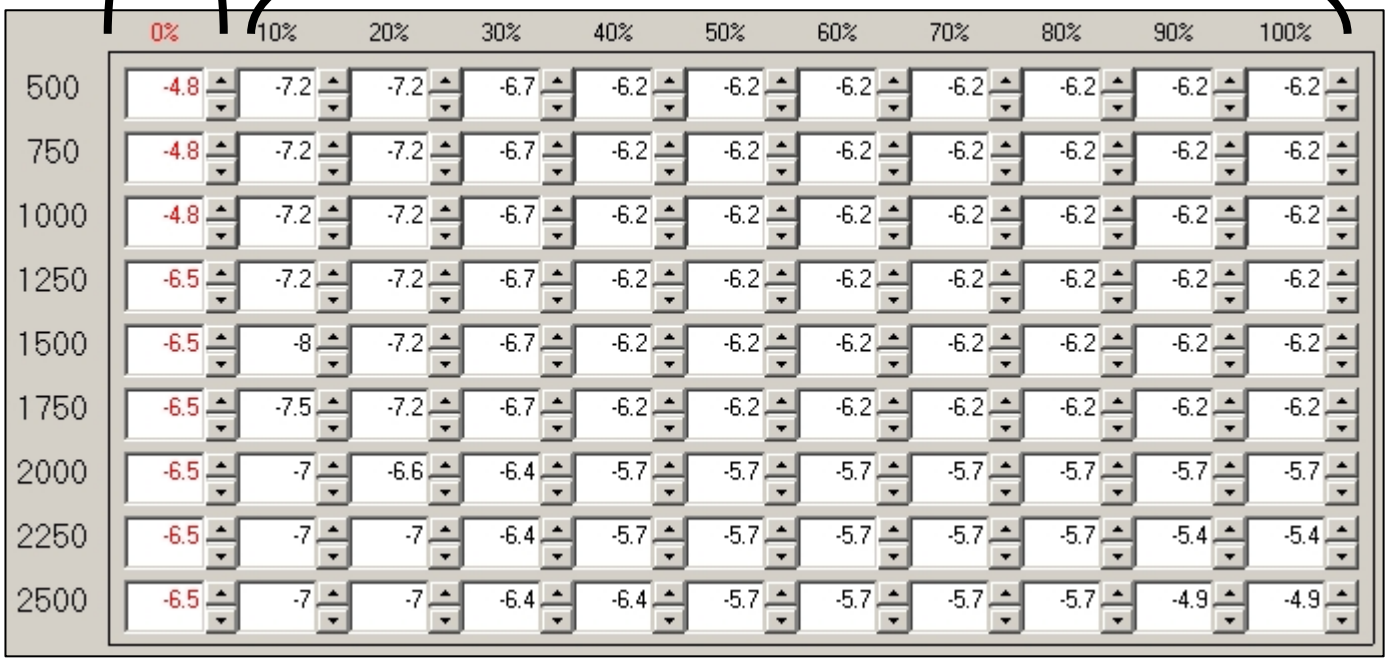
Modified Stock Injector Flow Scaling

- Start with a low value
  - The injectors may flow 816cc but do they match your MAF readings
    - You maybe flowing more air! BigMAF for example
  - Start with injector flow set at 740 (guess and what I usually use)
    - Increase this value while monitoring AFR curve with wideband O2 sensor
  - Fine tune AFR curve using a map overlay

Fuel Map Tuning

0% column applies to all RPM's below TPS cross over point

Past cross over point, Throttle > 25%, load is represented by Mass Absolute Pressure, MAP as defined in the SPECIAL CONSTANTS



	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
500	-4.8	-7.2	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
750	-4.8	-7.2	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
1000	-4.8	-7.2	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
1250	-6.5	-7.2	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
1500	-6.5	-8	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
1750	-6.5	-7.5	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
2000	-6.5	-7	-6.6	-6.4	-5.7	-5.7	-5.7	-5.7	-5.7	-5.7	-5.7
2250	-6.5	-7	-7	-6.4	-5.7	-5.7	-5.7	-5.7	-5.7	-5.4	-5.4
2500	-6.5	-7	-7	-6.4	-6.4	-5.7	-5.7	-5.7	-5.7	-4.9	-4.9

Fuel Tuning Table

- More positive numbers represent more fuel
  - A value of 2 is more fuel than an value of 1
  - A value of –6 is less fuel than a value of –5
    - Get the drift……

❖You are modifying the Mass Air Flow, MAF, voltage reading by a percentage

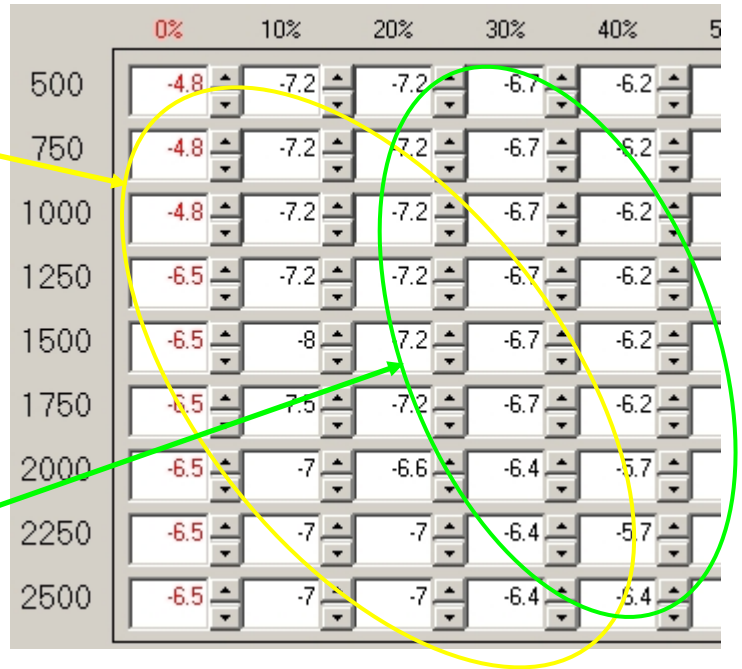
❖ Applies to both classic and open loop fueling modes

Fuel Tuning >TPS crossover Fueling for Rapid Spool Up

Always use a Wideband O2 sensor to tune your fuel values!

Over TPS crossover - UTEC load swaps to MAP

- Keep Low RPM and Low Boost Fuel values on the leaner side
- This creates *HOTTER* EGT's which helps the turbo spool quicker
- Richen up fuel at mid RPM and mid boost (Safer for your WRX if you don't have water injection)



- My AFR target was 12.5:1 up until 2750 RPM

What the MAF offsets actually does

RPM	MAP	Measured MAF	TPS	Site	Count	Ign#1	Inj#1	Ign	Fuel	Boost	Modified MAF	AFR
5042	+21.9	4.4	100	90	00	+17.0	68.1	+17.2	-4.8	ECU.	4.1	11.76

- In this example the actual measured MAF voltage is 4.4volts
  - The map applies a -4.8% modification resulting in a modified MAF voltage of 4.1 volts
- The Open Loop Fueling uses the modified MAF voltage value as the source of it's fuel lookup.
  - The UTEC has a pre-programmed background map that you cannot access.

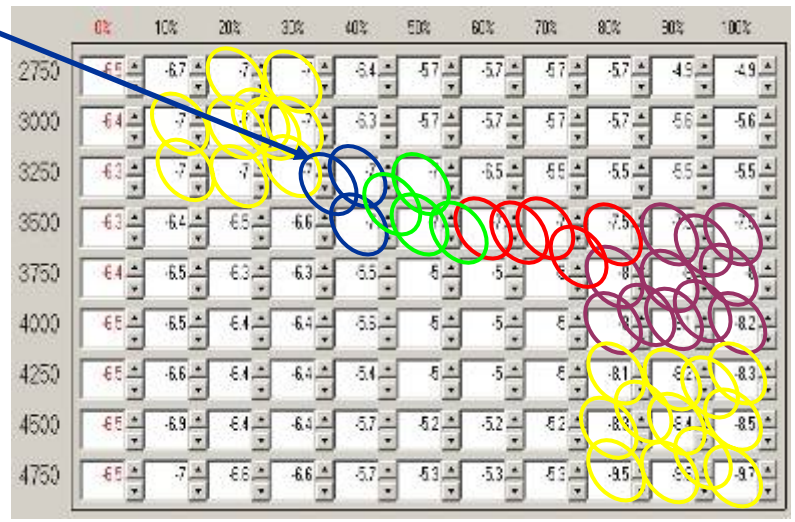
Fueling Part 2

Always use a Wideband O2 sensor to tune your fuel values!

RPM	MAP psig	MAF V	TPS %	Load Site	Knock Count	Ign#1 deg	Inj#1 duty	Mod Ign deg	Mod Fuel %	Boost (CL)	Mod MAF V
3115	+6.1	3.1	104	40	00	+19.0	24.0	+22.0	-7.5	320.00	2.9
3150	+7.0	3.2	104	40	00	+18.1	25.0	+22.0	-7.5	320.00	2.9
3202	+8.0	3.2	105	50	00	+15.8	28.0	+18.9	-7.5	320.00	3.1
3353	+9.0	3.4	105	50	00	+14.4	30.0	+19.0	-7.5	320.00	3.1
3436	+10.4	3.4	105	60	00	+12.6	33.0	+18.0	-7.5	320.00	3.3
3523	+12.1	3.5	105	70	00	+10.5	38.0	+17.0	-7.5	320.00	3.3
3654	+13.5	3.8	104	80	00	+9.4	43.0	+17.0	-8.1	320.00	3.4
3741	+15.3	3.8	105	90	00	+9.2	50.0	+17.1	-8.5	320.00	3.4
3858	+17.0	3.6	104	100	00	+10.1	51.0	+17.4	-8.5	320.00	3.6

AFR data is coming from Wideband Not shown.

Much easier with a TXS “Tuna”, AFR data right in the log file Or use UTI – See additional tuning tools at the end



- Log to correlate AFR/RPM/MAP data back to UTEC load column reference
- Adjust column to meet target AFR
- My AFR target was 11.5:1

Knock correction and Fuel Tuning

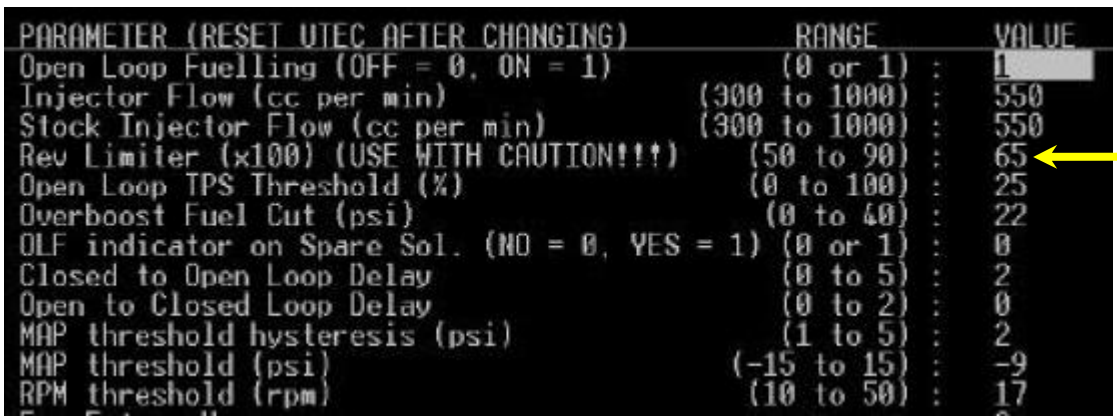
- Add fuel to correct knock conditions
  - WRX typical problem areas
    - Around 4000 RPM (peak boost)
    - Around 5500-5750 RPM (knock happy area)

- Stage4 Map example
  - Rich around 4000 RPM

Caution: Too much fuel will lead to misfire

Programmable Rev Limit

- Now UTEC controls fueling, it can also control rev limit – Way cool ☺
- Warning: Unless you have strengthened internals changing rev limit could cause serious engine damage



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Injector Flow (cc per min)	(300 to 1000) :	550
Stock Injector Flow (cc per min)	(300 to 1000) :	550
Rev Limiter (x100) (USE WITH CAUTION!!!)	(50 to 90) :	65
Open Loop TPS Threshold (%)	(0 to 100) :	25
Overboost Fuel Cut (psi)	(0 to 40) :	22
OLF indicator on Spare Sol. (NO = 0, YES = 1)	(0 or 1) :	0
Closed to Open Loop Delay	(0 to 5) :	2
Open to Closed Loop Delay	(0 to 2) :	0
MAP threshold hysteresis (psi)	(1 to 5) :	2
MAP threshold (psi)	(-15 to 15) :	-9
RPM threshold (rpm)	(10 to 50) :	17

STi Default is low IMO. Set if to 72 for a block with stock internals

Fuel Tuning

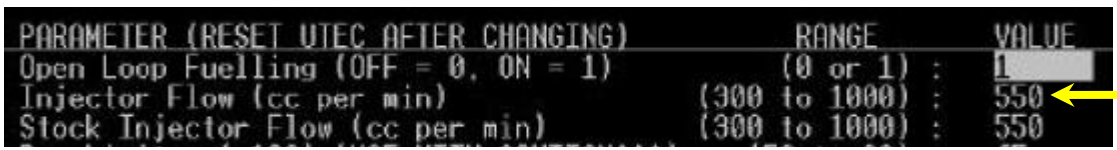
Speed Density Mode

Speed Density Parameter Setup

- In Speed Density (SD) mode the MAF sensor is only used BELOW crossover
  - After crossover fueling is calculated using a based volumetric efficiency table
    - Load points are RPM/MAP based after crossover
    - Base table can be offset using values in fuel table
    - MAF sensor is still required even in SD mode
- To Enable SD mode
  - OLF = 1 (on)
  - Fuel Mode = (SD mode on (MAF mode off))
    - Sorry I did not bother to capture a screen shot of the Fuel Mode on
- Don’t forget to set the engine CC, 2L or 2.5L
  - 2000, 2500

Speed Density Setup Continued

- Set UTEC injector size to ACTUAL size of injectors
  - Examples:
    - WRX with modified stock “blues”
      - Set Injector flow to ~800
    - STi with modified stock injectors
      - Set injector flow to ~800
    - If stock sized intake then set stock injectors to the size the ECU think are installed



Actual injector size

SD and the BigMAF

- Remember the MAF sensor is still used below UTEC crossover
- Still set the Injector size to the ACTUAL size of the injector (SD fueling is calculated from this value)
- Monitor the fuel trims as previously discussed and change the stock setting to bring the trims in line
  - Between 650-700 has worked

Injector Latency

- The use of the correct injector latency for given injectors in critical in getting the car to idle smoothly and the latency can be used to modify the lower load fueling
- Injector latency is the millisecond value added to the injector duty
  - Added to compensate for the injectors physical mechanical opening delay
  - Example:
    - Fuel trims are very minus at idle and light throttle
      - Increase the injector latency value a little adds fuel which should help with the lean condition
        - It’s a very small amount so should not offset the higher load fueling that much
        - If fueling is way off use the standard approach, injector scaling and 0% MAF modification

Sample Injector Latency values

- Base information from NASIOC thread
  - Additional “real life” tuning information added

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TOP FEED injectors. Used In the WRX or JDM STI platform:

Stock Blue injectors: 728/420CC
STI Pink injectors: 728/ 550CC
PE 650's : 1500/650CC
PE 800's : 1600/850CC
Helix 660: 1180/660cc
UR 785s: 770/785CC
UR 785 D type 540/785CC
Helix 820CC: 1120/820CC
RC 650: 960/650cc

SIDE FEED injectors:

Stock US STI: 1050/500CC (We use 1300 for SD) (800 if using MAF and base map)
Nismo 720cc : 880/720CC
PE850s : 850/850CC
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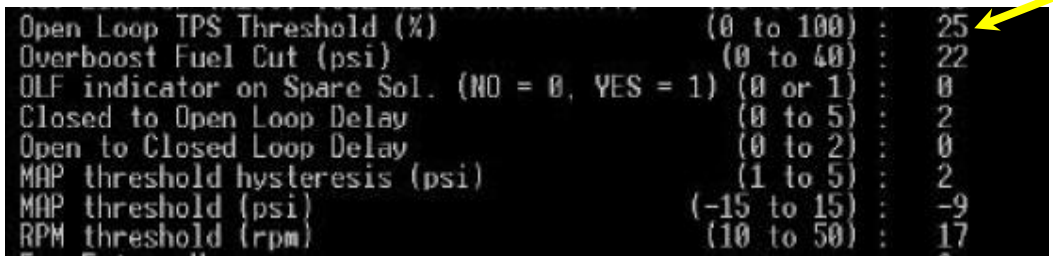
A value a little smaller works a little better than the actual latency values specified

TPS Crossover

- All crossover parameters have to be true for UTEC to go into SD mode
  - TPS / MAP / RPM settings



TPS is fine at 25% unless you really want to tune the 10-20% MLP for a smooth crossover

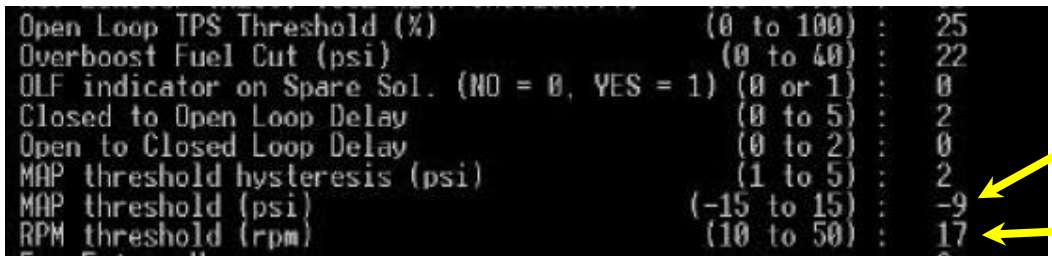
Setting it to 0 means that as soon as the other parameters are met the UTEC enables SD mode fueling

If set at 0 tuning of the 10-20% MLP is very important. Tune them to 14.7-14.5:1 AFR

Leaving TPS at 25% means cruise AFR is typically under ECU closed loop control, which is good for fuel efficiency

MAP/RPM Crossover

- MAP crossover is split between two values
  - To calculate the actual MAP crossover point
    - Take the MAP threshold then add the MAP hysteresis value to it
    - Example
      - MAP Threshold = -9 psi
      - MAP Hysteresis = 2 psi
        - Crossover happens at -7psi (As long as all other crossover parameters are true)



Default settings work pretty well

Default RPM setting is fine

Speed Density Fuel Tuning

- Spend time tuning the low end of the fuel map. This will make for a smooth ECU to UTEC transition

Tune lower load points at as many rpm points as possible

Volumetric Efficiency (VE). With 0 in the map this would read 100

1345	-2.1	2.2	15	10	0	14.9	19.9	5.3	20.0	78	ECU	2.2	14.93
1431	-2.1	2.2	15	10	0	14.5	21.0	5.6	20.0	77	ECU	2.2	14.49
1501	-2.1	2.2	15	10	0	14.4	20.6	6.6	20.0	77	ECU	2.3	14.42
1558	-2.1	2.2	16	10	0	14.6	20.5	7.0	20.0	77	ECU	2.2	14.61
1605	-2.1	2.3	17	10	0	14.9	21.7	7.2	20.0	76	ECU	2.3	14.91
1675	-1.6	2.3	19	10	0	15.0	22.6	7.7	20.0	77	ECU	2.4	14.96
1758	-1.1	2.4	21	10	0	14.7	22.5	8.7	20.0	80	ECU	2.3	14.70
1863	-1.1	2.4	21	10	0	14.3	24.0	9.4	20.0	82	ECU	2.4	14.30
1967	-1.1	2.5	22	10	0	13.7	25.4	10.0	20.0	83	ECU	2.5	13.73

Lean and mean

Example SD Fuel Map

	0	10	20	30	40	50	60	70	80	90	100
500	0	-15	-16	-14.5	-13	-14	-14	-15	-15	-15	-15
750	0	-13	-16	-14.5	-13	-14	-14	-15	-15	-15	-15
1000	0	-16.3	-16	-14.5	-13	-14	-14	-15	-15	-15	-15
1250	0	-16	-16	-14.5	-13	-14	-14	-15	-15	-15	-15
1500	0	-16	-10.2	-14.5	-13	-14	-14	-15	-15	-15	-15
1750	-0.5	-16	-12	-10	-10	-10	-10	-10	-10	-10	-10
2000	-1	-16	-12	-10	-10	-10	-10	-10	-10	-10	-10
2250	-1	-16	-12.1	-10	-10	-10	-10	-10	-10	-10	-10
2500	-1	-16	-12.9	-10	-10	-10	-10	-10	-10	-10	-10
2750	-1	-16.1	-9.2	-10	-10	-10	-10	-10	-10	-10	-10
3000	-1	-15.1	-8.5	-6.8	-9	-9	-9	-9	-9	-9	-9
3250	-1	-15	-11.3	-8.4	-9.3	-11	-11	-11	-11	-11	-11
3500	-1	-15	-10.2	-9.3	-11.4	-11.9	-12.5	-12.5	-11.5	-10.5	-10.5
3750	-1	-15	-10	-10.8	-11.5	-13.3	-12.8	-12.9	-12.5	-11.5	-10.5
4000	-1	-15	-10	-9.3	-9.3	-14.1	-16.5	-15.5	-12	-11	-10
4250	-1	-15	-10	-9.5	-8.8	-11.3	-14.8	-16.2	-11	-10	-10
4500	-1	-15	-10	-10.2	-8.5	-10.3	-13.9	-15.9	-11	-10	-10
4750	-1	-15	-10	-10.2	-9	-9.8	-10.9	-12.4	-10	-9	-9
5000	-1	-15	-10	-10.7	-9	-9.4	-9.7	-11.2	-8.8	-8	-8
5250	-1	-15	-10	-10.7	-9	-9.2	-9.6	-9.5	-7.9	-7	-7
5500	-1	-15	-10	-9.6	-8.8	-9.2	-8.8	-8.9	-7.3	-6.5	-6.5
5750	-1	-15	-10	-8.4	-8.6	-8.9	-8.7	-8.8	-7.3	-6.5	-6.5
6000	-1	-14.5	-10	-7.5	-8.6	-8.8	-8.7	-8.5	-7.4	-6.5	-6.5
6250	-1	-14.5	-10	-7.7	-8.4	-8.8	-6.8	-9.2	-7.4	-6.5	-6.5
6500	-1	-14.5	-10	-8.7	-8.6	-9.7	-10.6	-11.4	-10.9	-9.5	-9.5
6750	-1	-14.5	-10	-9	-10.1	-11.7	-11.3	-12	-12	-11	-10
7000	-1	-14.5	-10	-9	-11	-11.2	-9.7	-12	-12	-11	-10
7250	-1	-14.5	-10	-9	-9.6	-9.6	-10.5	-10.5	-11	-11	-10
7500	-1	-14.5	-10	-9.5	-9	-8.5	-9.5	-9.5	-10	-10	-9
7750	-1	-14.5	-10	-9.5	-9	-8.5	-7.5	-7.5	-7	-7	-7
8000	-1	-14.5	-10	-9.5	-9	-8.5	-7.5	-7.5	-7	-7	-7
8250	-1	-8	-8	-8	-8	-7	-7.5	-7.5	-7	-7	-7
8500	-1	-8	-8	-8	-8	-7	-7.5	-7.5	-7	-7	-7
8750	-1	-8	-8	-8	-8	-7	-7.5	-7.5	-7	-7	-7
9000	-1	-8	-8	-8	-8	-7	-7.5	-7.5	-7	-7	-7

With injector size and latency set correctly the fuel map typically has to remove lots of fuel at the lower load points and RPM to achieve 14:1

Higher loads and RPM requires less modification from the UTEC’s base fueling map to achieve 11:1

Tune map in same way as any other fuel mode

SD Mode and Temperature

- Speed Density is affected by temperature
  - Typically only intake temp fueling compensation is needed
    - Coolant correction should be used if you have cold/hot start problems

PARAMETER (RESET UTEC AFTER CHANGING)	RANGE	VALUE
Coolant Fuel Correction 30C (%)	(0 to 20) :	0
Coolant Fuel Correction 60C (%)	(0 to 20) :	0
Coolant Fuel Correction 90C (%)	(0 to 20) :	0
Coolant Fuel Correction 120C (%)	(0 to 20) :	0
Coolant Ign Correction 30C (%)	(-10 to 10) :	0
Coolant Ign Correction 60C (%)	(-10 to 10) :	0
Coolant Ign Correction 90C (%)	(-10 to 10) :	0
Coolant Ign Correction 120C (%)	(-10 to 10) :	0
Intake Temp Fuel Correction 0C (%)	(-10 to 10) :	
Intake Temp Fuel Correction 30C (%)	(-10 to 10) :	
Intake Temp Fuel Correction 60C (%)	(-10 to 10) :	
Intake Temp Fuel Correction 90C (%)	(-10 to 10) :	
Intake Temp Ign Correction 0C (%)	(-10 to 10) :	0
Intake Temp Ign Correction 30C (%)	(-10 to 10) :	0
Intake Temp Ign Correction 60C (%)	(-10 to 10) :	0
Intake Temp Ign Correction 90C (%)	(-10 to 10) :	0

Add fuel when it's colder than tune temp

Remove fuel when it's hotter than tune temp

Interesting Log

- This is log pretty interesting and shows the power of Speed Density Mode
  - Can you see why?

5610	+19.9	4.9	100	70	0	11.2	14.3	71.3	15.9	91	ECU	4.6	11.17
5704	+20.3	4.9	100	70	0	11.2	14.9	73.7	17.0	91	ECU	4.6	11.20
5845	+20.3	4.8	100	70	0	11.2	15.0	76.8	16.8	91	ECU	4.6	11.24
5947	+20.8	4.9	100	70	0	11.2	14.6	78.8	17.6	92	ECU	4.6	11.20
6006	+20.8	5.0	100	70	0	11.2	14.6	80.9	17.6	92	ECU	4.6	11.17
6051	+20.3	4.9	100	70	0	11.1	14.6	80.4	17.8	92	ECU	4.6	11.11
6067	+19.9	4.8	100	70	0	11.1	14.3	83.6	18.5	92	ECU	4.6	11.05
6251	+19.4	4.8	100	70	0	11.1	14.5	82.7	19.8	91	ECU	4.6	11.05
6408	+19.9	4.9	100	70	0	11.1	15.3	81.4	19.6	91	ECU	4.6	11.12

- Answer: The MAF sensor is pegged!
  - This is not an issue as it’s only used below crossover.
    - That’s one smooth fuel curve

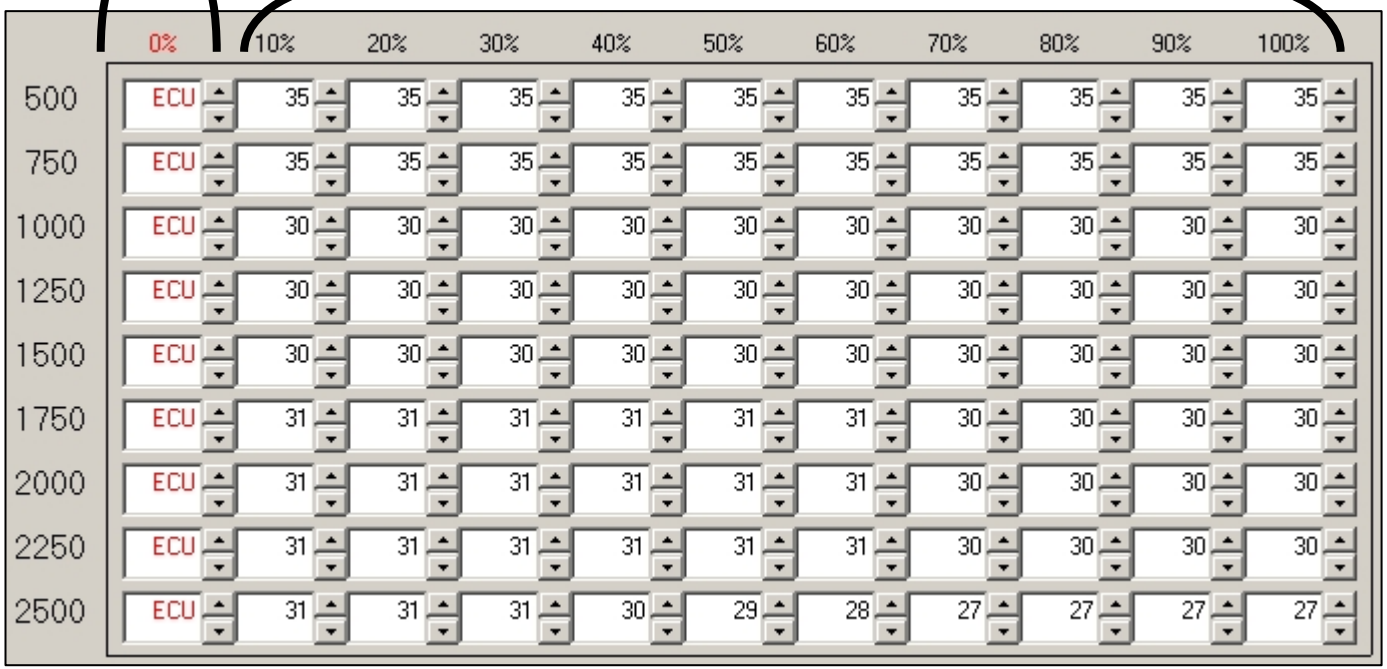
Timing Tuning

Timing ninja fu

Timing Map Tuning

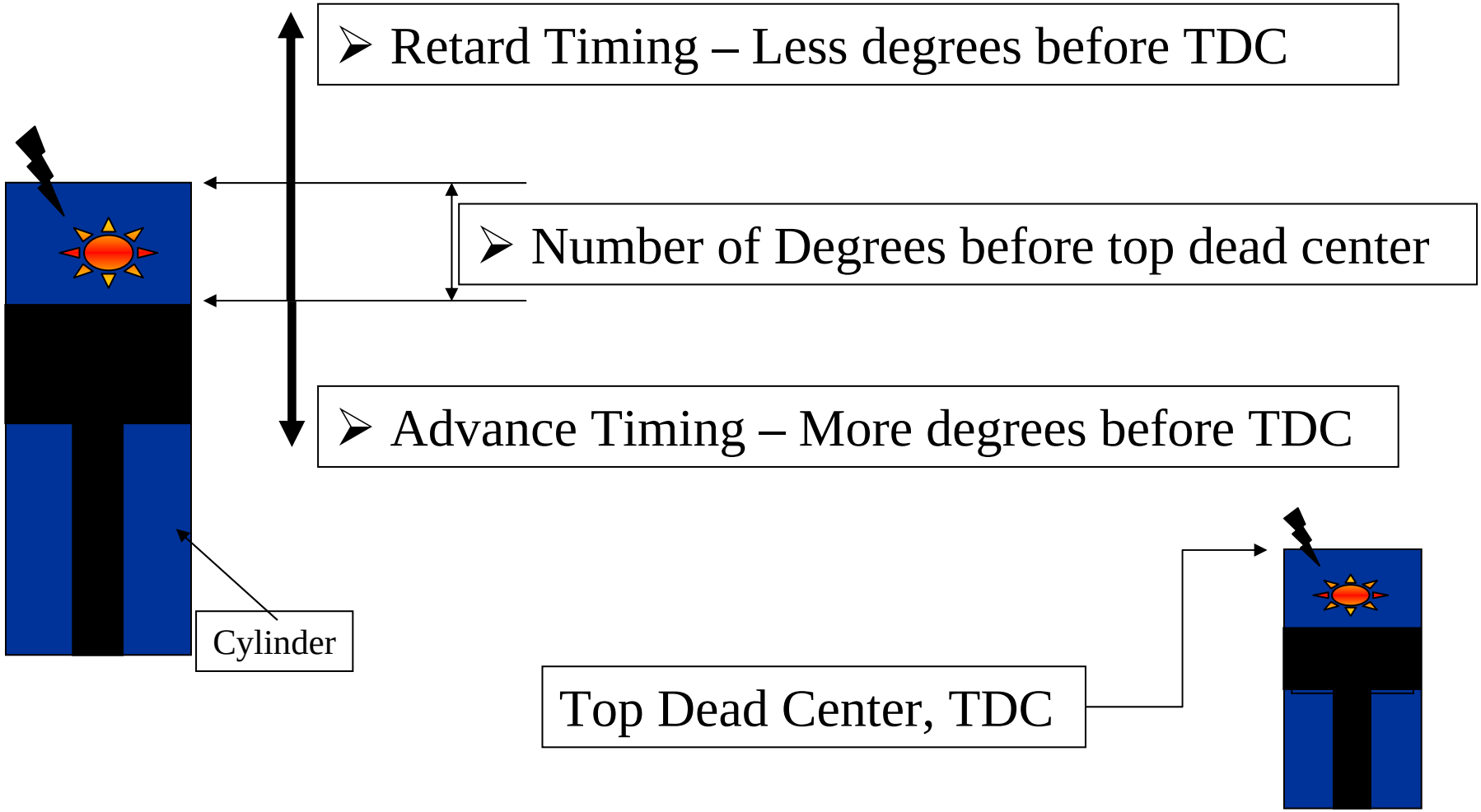
0% column applies to all RPM's below TPS cross over point

Past cross over point, Throttle load is represented by Mass Absolute Pressure, MAP as defined in the SPECIAL CONSTANTS



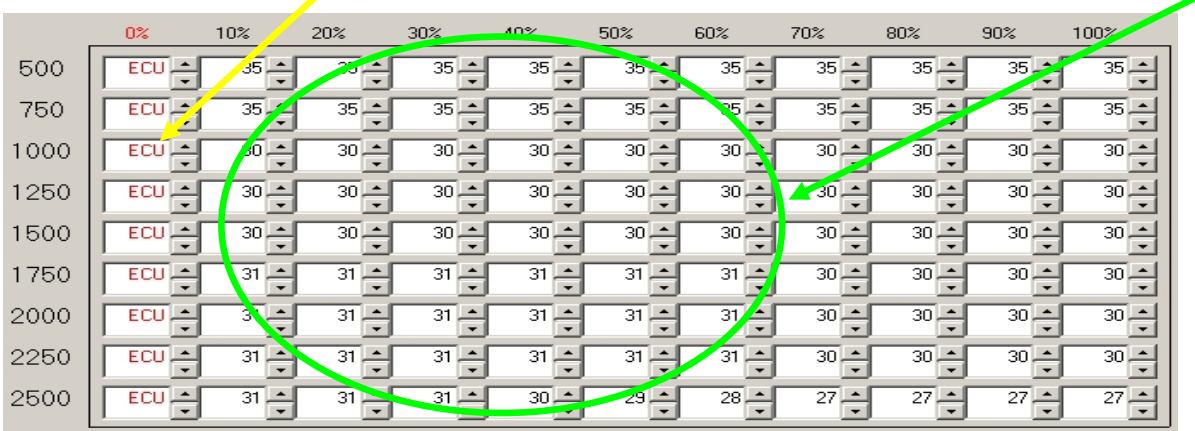
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
500	ECU	35	35	35	35	35	35	35	35	35	35
750	ECU	35	35	35	35	35	35	35	35	35	35
1000	ECU	30	30	30	30	30	30	30	30	30	30
1250	ECU	30	30	30	30	30	30	30	30	30	30
1500	ECU	30	30	30	30	30	30	30	30	30	30
1750	ECU	31	31	31	31	31	31	30	30	30	30
2000	ECU	31	31	31	31	31	31	30	30	30	30
2250	ECU	31	31	31	31	31	31	30	30	30	30
2500	ECU	31	31	31	30	29	28	27	27	27	27

Timing Advance / Retard



Timing Adjustment

- Issue: Default maps don't have timing down in the 10-60% columns – Can cause knock when control passes from ECU to UTEC and back. Needed for cars with BigMAF
  - Resolution: Move timing values into those area
    - LEAVE lower RPM 0% under ECU control

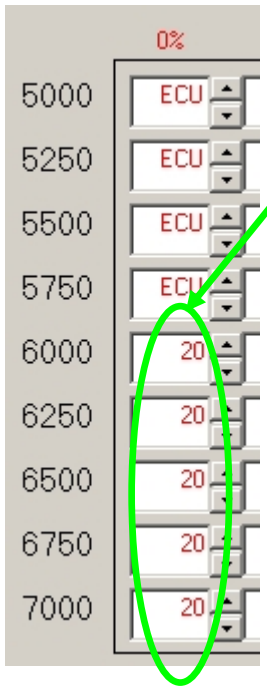


Smooth transitions in timing minimizes the chance of knock

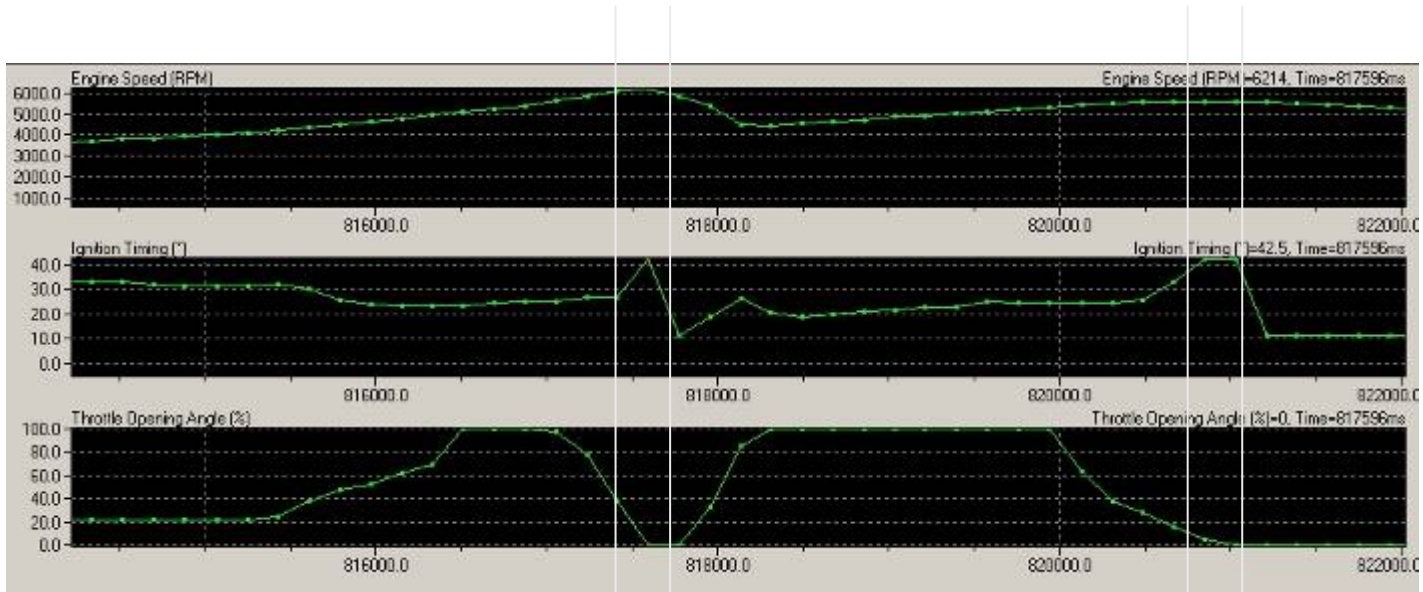
Try to limit steps in timing to less than 3 degrees

Knock after shift (timing correction)

Use conservative timing values in upper 0% column to minimize the chance of knock after shift

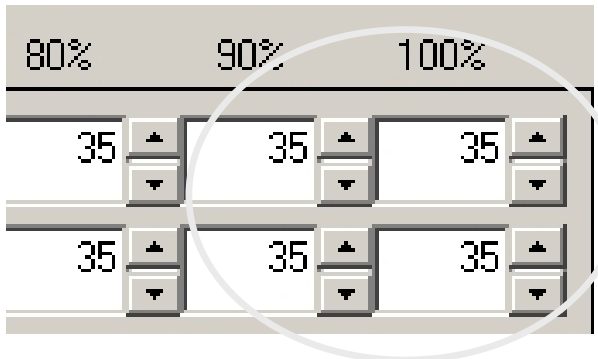


ECU runs huge timing advance after high RPM shift. This can cause knock after shift conditions



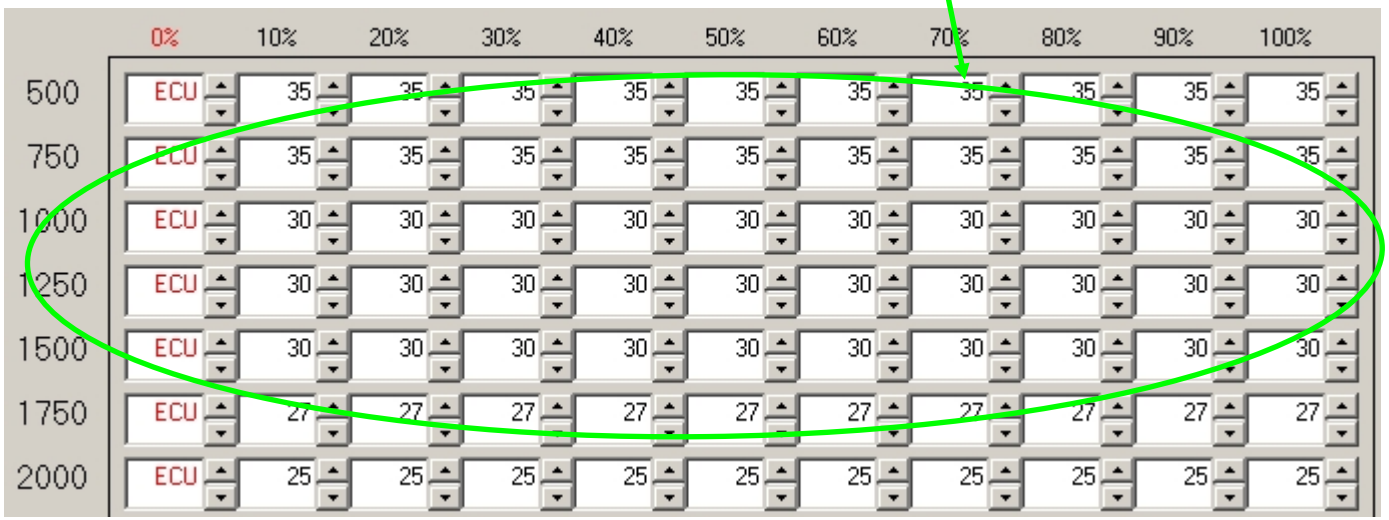
Too much advance!

- Too much advance leads to KNOCK and engine destruction!
- At redline, too much advance means very high cylinder pressure
  - BANG – Dead WRX/STi
- At a point, more advance does not yield more power
  - At that point more advance just takes you closer to knock
  - Back timing off 1-2-3 points to create a safe map
    - Dyno Proven



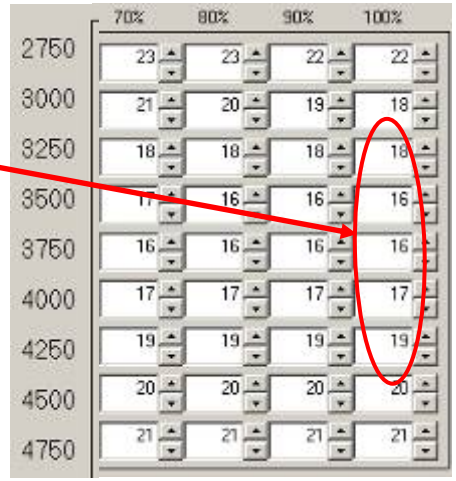
Timing Low Down

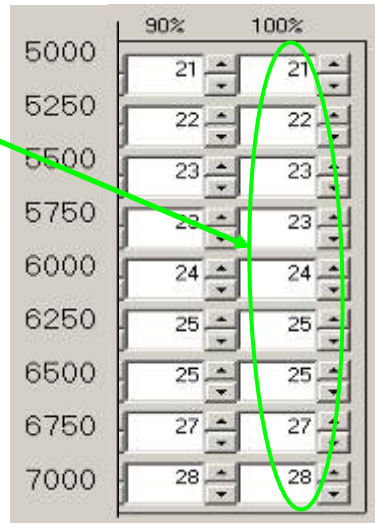
- Retarding ignition would increase EGT's thus help spool up
  - ✘ Negatives: Loss of power because of reduced timing
- ✓ BETTER: Advance timing at the low RPM's
  - ✓ More advance means more power



Timing Values Mid to Top End

- Watch for knock in the mid rpm range
  - Minimal advance here is good ☺
- After 3750 or boost peak RPM's start ramping timing up
  - 22 – 26 degrees of advance should be safe at redline
  - Smooth Transitions, steps of 1-3 are best
- Watch for KNOCK !
  - If you get knock, back off the timing 1-2-3 degrees at LEAST





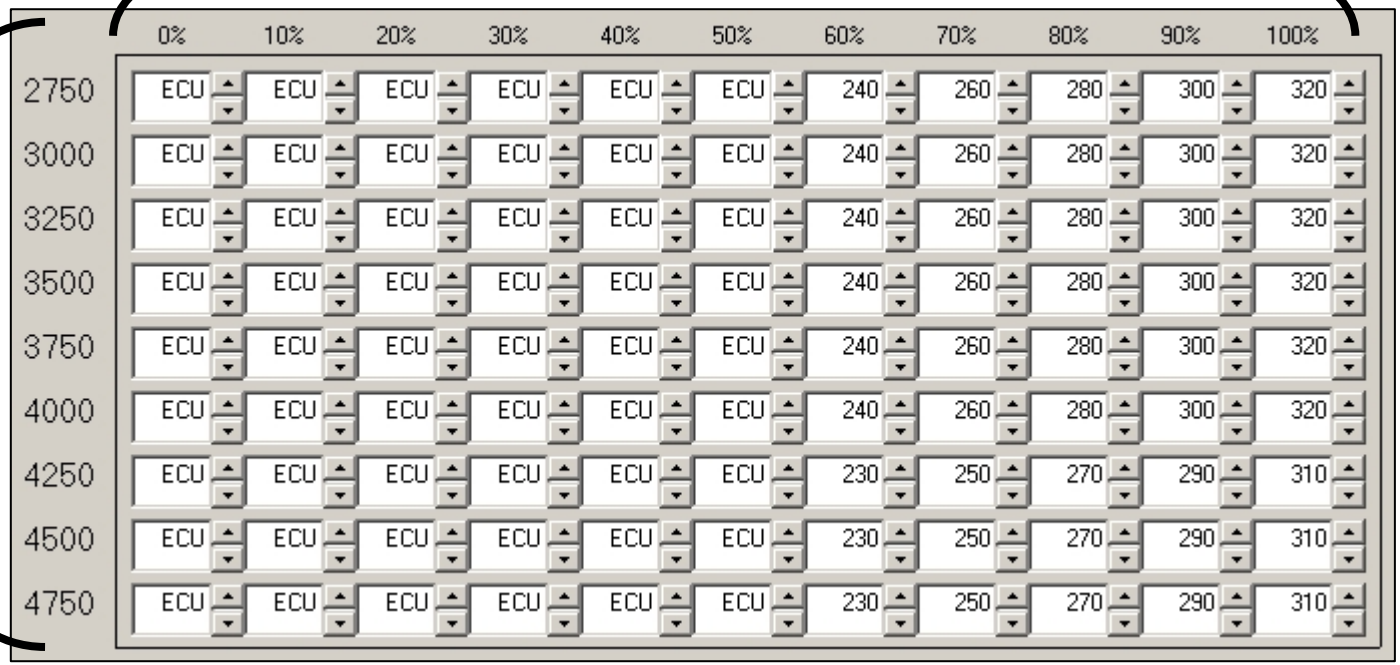
UTEC Boost Controller Setup

Boost Map Tuning

Boost Control is TPS/RPM based

TPS

RPM

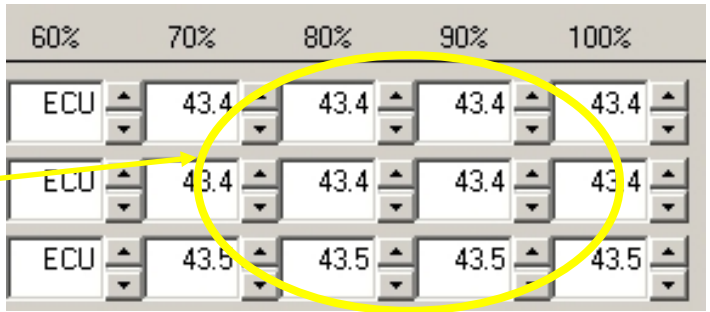


Boost control modes summary

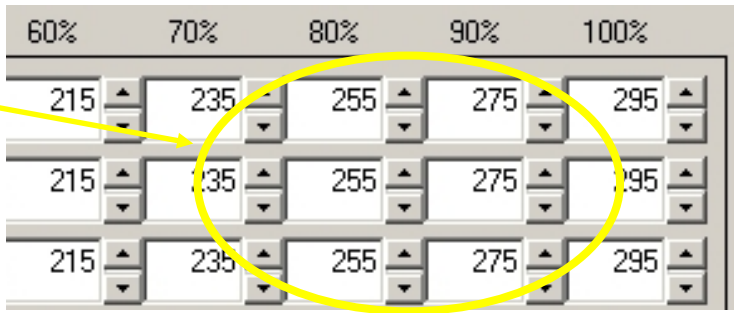
- Open Loop Mode
  - Can’t think of a reason to use this mode
- Closed Loop Mode
  - Advantage: Ramped Boost – Different targets based on TPS/RPM
  - Disadvantage: Affected by temperature
- PID Mode
  - Advantage: Rock solid boost once tuned
  - Disadvantage: Boost target is RPM based only

Open Loop / Closed Loop Boost Control

- Open Loop (Default)
  - UTEC map sets boost solenoid duty cycle



- Closed Loop
  - UTEC map defines target boost unit, UTEC automatically changes solenoid duty cycle to hit boost target



Open loop control

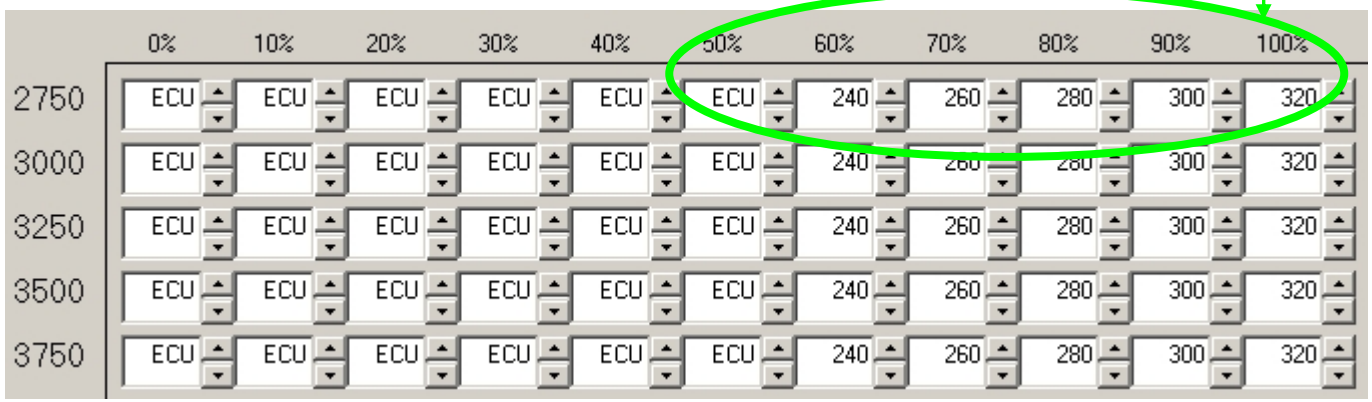
- I just stuck with the TurboXS map until closed loop was introduced
  - Used bleed valve to set max boost value

Sorry No More Information Available

Closed Loop Control

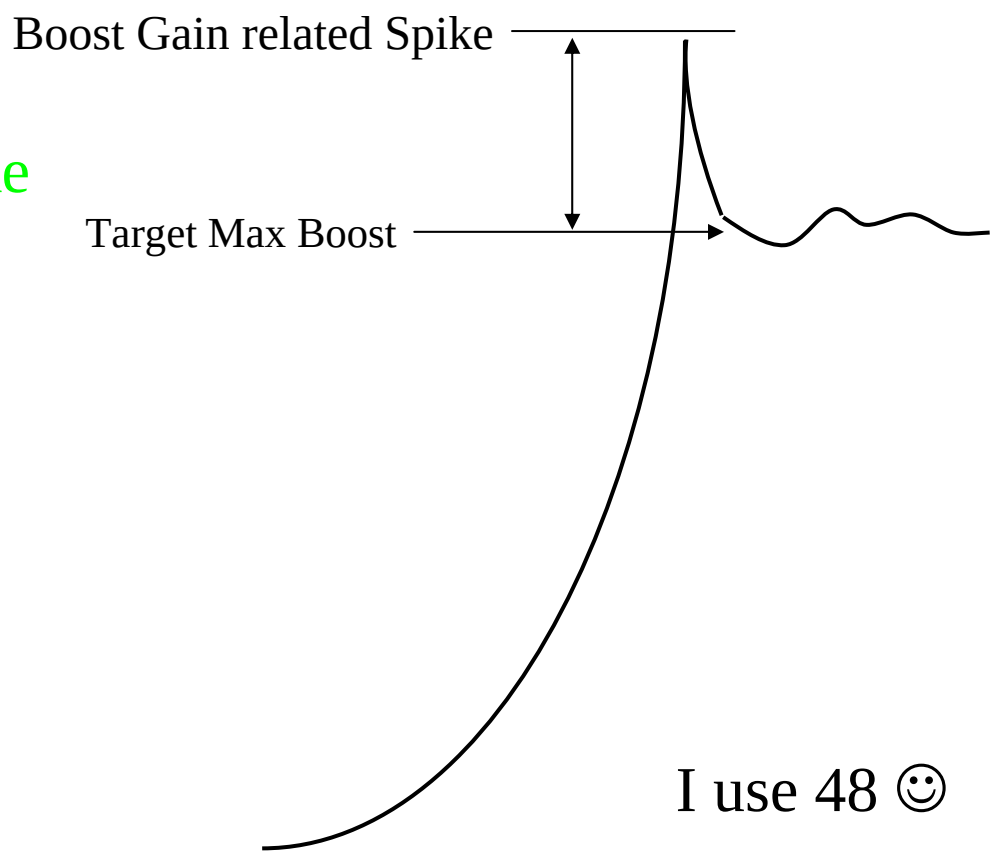
- Don’t forget to enable closed loop boost control in special constants
- Start with low numbers and work up
  - Bleed valve effects max boost (set at open 2-3 turns and forget)
  - Boost Gain value effects max boost
    - 45-50 seems to work best
    - Effects boost ramp as well

Ramp up the boost, this will make part throttle control feel smooth



Closed Loop Boost Gain

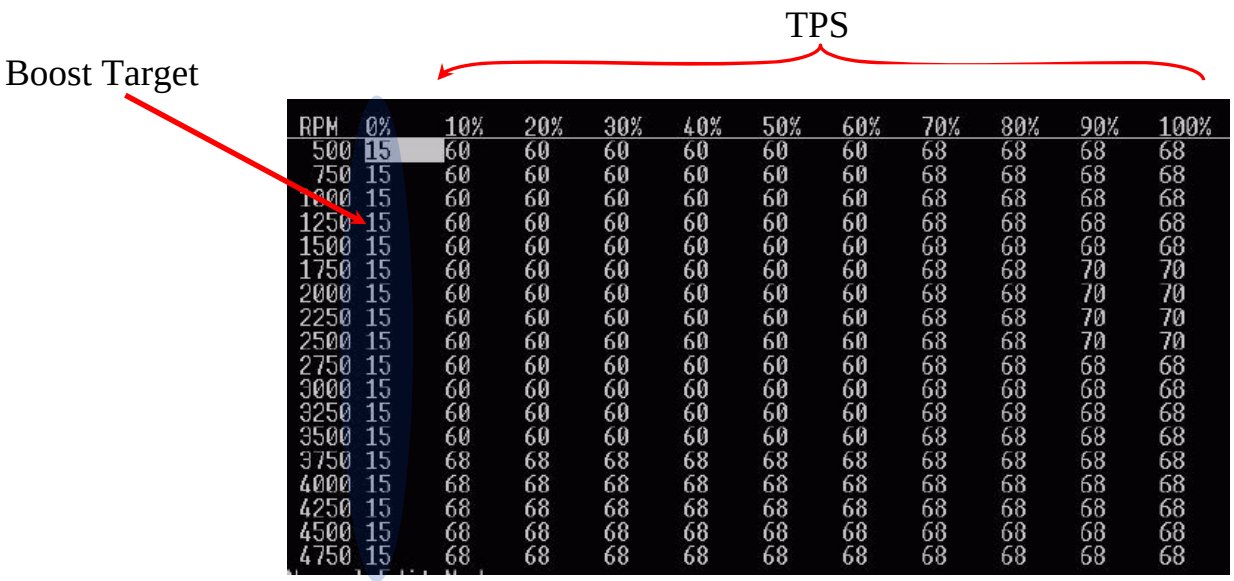
- Lower Boost Gain Values =
  - Quicker Boost Ramp up
  - Bigger boost spike
    - 45 can yield ~1 psi spike
- Higher Boost Gain Values =
  - Slower Boost Ramp up
  - Smaller boost spikes
    - 50 yields ~0 psi spike
- Caution: Boost Gain effects MAX boost value



I use 48 ☺

UTEC PID Boost Control

- Easy to setup (Enable in Special Constants)
  - 0% column = Boost Target
  - 10-100% = Starting duty cycle
    - Gain setting is used to control ramp
  - Load is TPS / RPM based



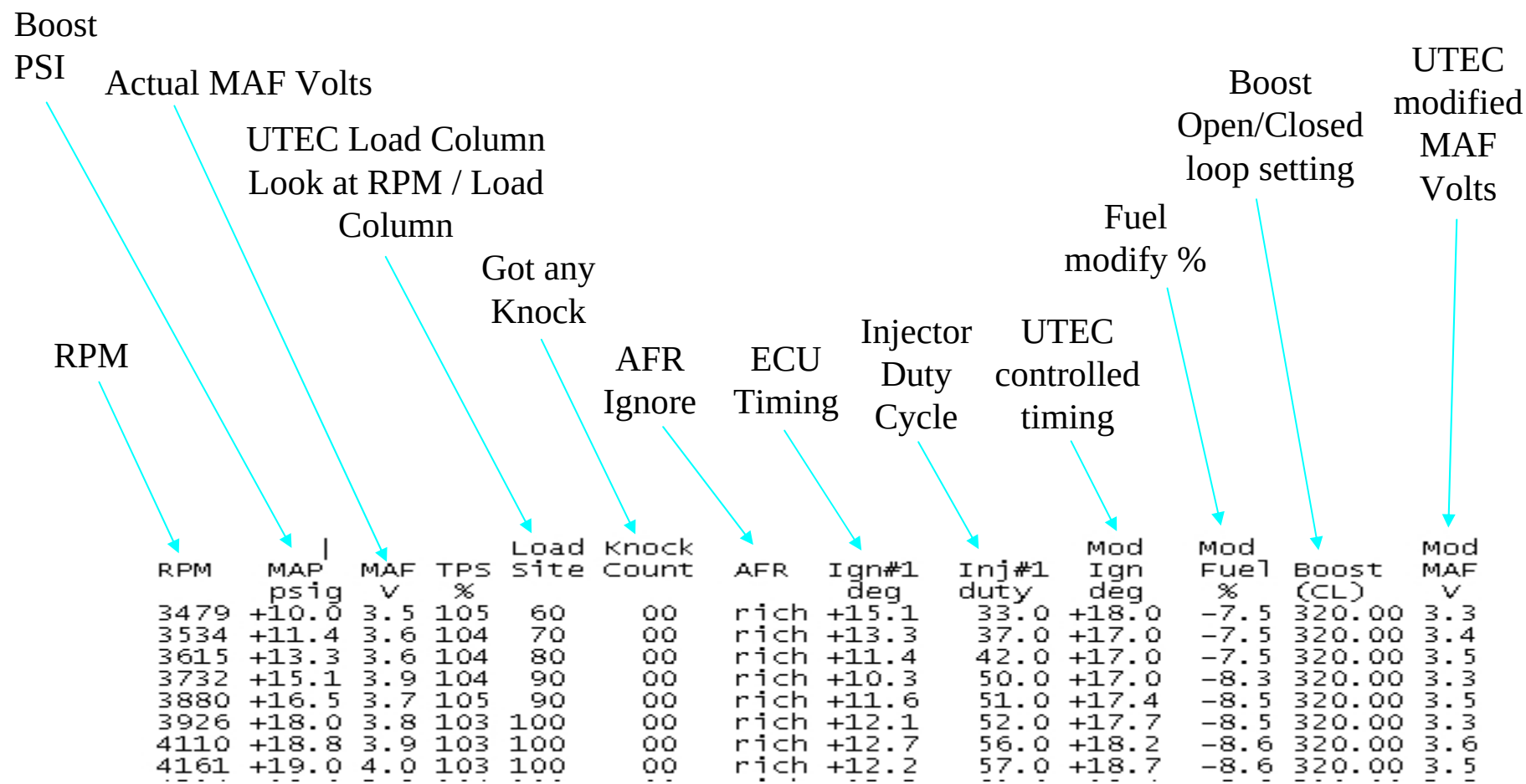
RPM	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
500	15	60	60	60	60	60	60	68	68	68	68
750	15	60	60	60	60	60	60	68	68	68	68
1000	15	60	60	60	60	60	60	68	68	68	68
1250	15	60	60	60	60	60	60	68	68	68	68
1500	15	60	60	60	60	60	60	68	68	68	68
1750	15	60	60	60	60	60	60	68	68	70	70
2000	15	60	60	60	60	60	60	68	68	70	70
2250	15	60	60	60	60	60	60	68	68	70	70
2500	15	60	60	60	60	60	60	68	68	70	70
2750	15	60	60	60	60	60	60	68	68	68	68
3000	15	60	60	60	60	60	60	68	68	68	68
3250	15	60	60	60	60	60	60	68	68	68	68
3500	15	60	60	60	60	60	60	68	68	68	68
3750	15	68	68	68	68	68	68	68	68	68	68
4000	15	68	68	68	68	68	68	68	68	68	68
4250	15	68	68	68	68	68	68	68	68	68	68
4500	15	68	68	68	68	68	68	68	68	68	68
4750	15	68	68	68	68	68	68	68	68	68	68

UTEC Parameters

- Split into Five sections
  - User
  - Knock
  - Special
  - Fueling
  - Temperature Compensation
- It’s best to read the UTEC users manual to understand these. They are fully explained in the manual.

Logging

- Log 1 seems to be the best for daily logging



RPM	MAP psig	MAF v	TPS %	Load Site	Knock Count	AFR	Ign#1 deg	Inj#1 duty	Mod Ign deg	Mod Fuel %	Boost (CL)	Mod MAF v
3479	+10.0	3.5	105	60	00	rich	+15.1	33.0	+18.0	-7.5	320.00	3.3
3534	+11.4	3.6	104	70	00	rich	+13.3	37.0	+17.0	-7.5	320.00	3.4
3615	+13.3	3.6	104	80	00	rich	+11.4	42.0	+17.0	-7.5	320.00	3.5
3732	+15.1	3.9	104	90	00	rich	+10.3	50.0	+17.0	-8.3	320.00	3.3
3880	+16.5	3.7	105	90	00	rich	+11.6	51.0	+17.4	-8.5	320.00	3.5
3926	+18.0	3.8	103	100	00	rich	+12.1	52.0	+17.7	-8.5	320.00	3.3
4110	+18.8	3.9	103	100	00	rich	+12.7	56.0	+18.2	-8.6	320.00	3.6
4161	+19.0	4.0	103	100	00	rich	+12.2	57.0	+18.7	-8.6	320.00	3.5

Log Debugging

Always look at the values that lead up to the knock event

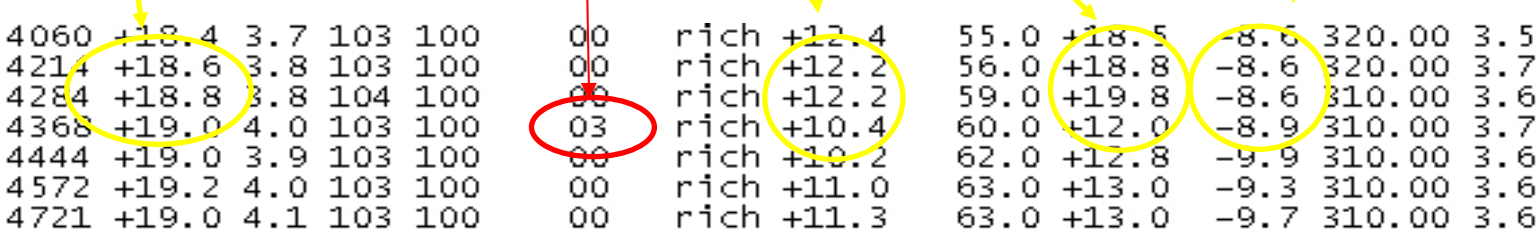
Boost, Timing, Fuel

Too much Boost ?

UTEC running too much timing advance? The ECU did not want to run that much timing

Too Lean ?

Knock



4060	+18.4	3.7	103	100		00	rich	+12.4	55.0	+18.5	-8.6	320.00	3.5
4214	+18.6	3.8	103	100		00	rich	+12.2	56.0	+18.8	-8.6	320.00	3.7
4284	+18.8	3.8	104	100		00	rich	+12.2	59.0	+19.8	-8.6	310.00	3.6
4368	+19.0	4.0	103	100		03	rich	+10.4	60.0	+12.0	-8.9	310.00	3.7
4444	+19.0	3.9	103	100		00	rich	+10.2	62.0	+12.8	-9.9	310.00	3.6
4572	+19.2	4.0	103	100		00	rich	+11.0	63.0	+13.0	-9.3	310.00	3.6
4721	+19.0	4.1	103	100		00	rich	+11.3	63.0	+13.0	-9.7	310.00	3.6

UTEC GUI’s

Third Party Tuning Tools

UTEC Interface – UTI

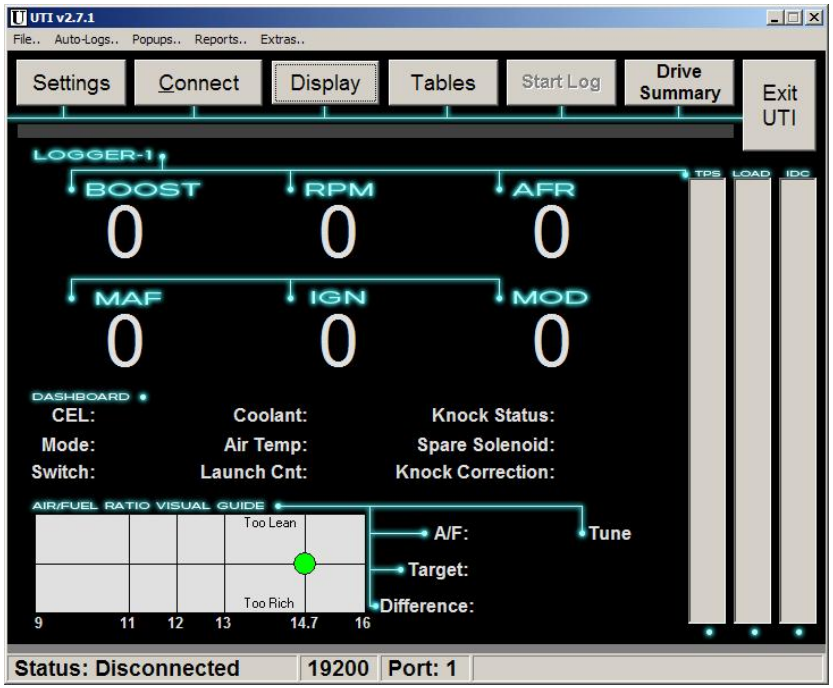
Author - navybluesubaru

- UTI is by far the best thirty party UTEC interface on the market
  - UTI is Free (Donations accepted and recommended)
  - UTI when used with a wideband O2 will help you fuel tune
  - Automated logging, alarms and a great dashboard GUI
- http://www.dezignduo.com/UTI/phpBB2/
  - Read above forum notes to understand usage model

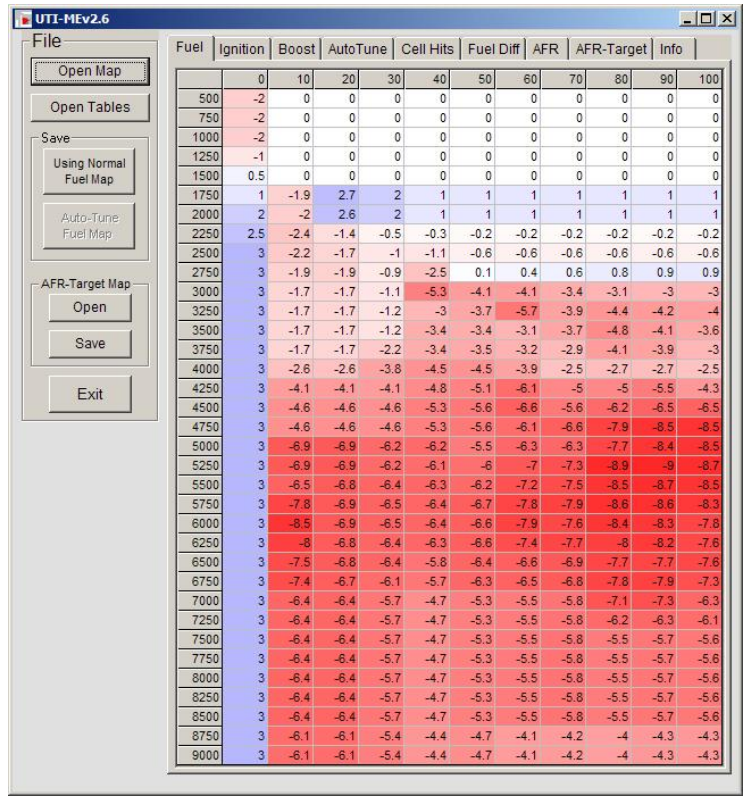
UTEC Interface – UTI

Author - navybluesubaru

UTI (Dashboard view)



UTI Map Editor – Post process table files and automate the fuel map update

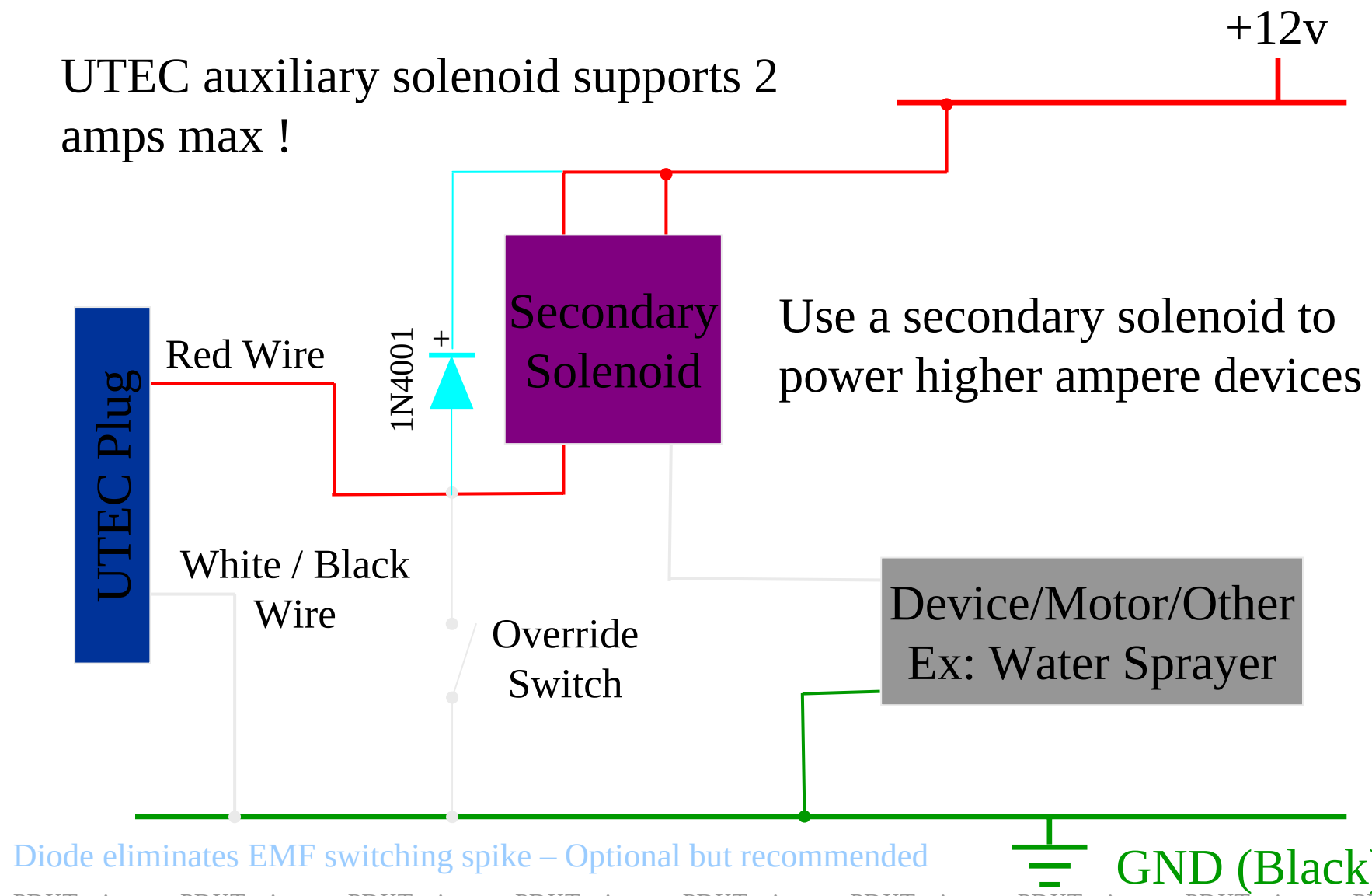


	0	10	20	30	40	50	60	70	80	90	100
500	-2	0	0	0	0	0	0	0	0	0	0
750	-2	0	0	0	0	0	0	0	0	0	0
1000	-2	0	0	0	0	0	0	0	0	0	0
1250	-1	0	0	0	0	0	0	0	0	0	0
1500	0.5	0	0	0	0	0	0	0	0	0	0
1750	1	-1.9	2.7	2	1	1	1	1	1	1	1
2000	2	-2	2.6	2	1	1	1	1	1	1	1
2250	2.5	-2.4	-1.4	-0.5	-0.3	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
2500	3	-2.2	-1.7	-1	-1.1	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
2750	3	-1.9	-1.9	-0.9	-2.5	0.1	0.4	0.6	0.8	0.9	0.9
3000	3	-1.7	-1.7	-1.1	-5.3	-4.1	-4.1	-3.4	-3.1	-3	-3
3250	3	-1.7	-1.7	-1.2	-3	-3.7	-5.7	-3.9	-4.4	-4.2	-4
3500	3	-1.7	-1.7	-1.2	-3.4	-3.4	-3.1	-3.7	-4.8	-4.1	-3.6
3750	3	-1.7	-1.7	-2.2	-3.4	-3.5	-3.2	-2.9	-4.1	-3.9	-3
4000	3	-2.6	-2.6	-3.8	-4.5	-4.5	-3.9	-2.5	-2.7	-2.7	-2.5
4250	3	-4.1	-4.1	-4.1	-4.8	-5.1	-6.1	-5	-5	-5.5	-4.3
4500	3	-4.6	-4.6	-4.6	-5.3	-5.6	-6.6	-5.6	-6.2	-6.5	-6.5
4750	3	-4.6	-4.6	-4.6	-5.3	-5.6	-6.1	-6.6	-7.9	-8.5	-8.5
5000	3	-6.9	-6.9	-6.2	-6.2	-5.5	-6.3	-6.3	-7.7	-8.4	-8.5
5250	3	-6.9	-6.9	-6.2	-6.1	-6	-7	-7.3	-8.9	-9	-8.7
5500	3	-6.5	-6.8	-6.4	-6.3	-6.2	-7.2	-7.5	-8.5	-8.7	-8.5
5750	3	-7.8	-6.9	-6.5	-6.4	-6.7	-7.8	-7.9	-8.6	-8.6	-8.3
6000	3	-8.5	-6.9	-6.5	-6.4	-6.6	-7.9	-7.6	-8.4	-8.3	-7.8
6250	3	-8	-6.8	-6.4	-6.3	-6.6	-7.4	-7.7	-8	-8.2	-7.6
6500	3	-7.5	-6.8	-6.4	-5.8	-6.4	-6.6	-6.9	-7.7	-7.7	-7.6
6750	3	-7.4	-6.7	-6.1	-5.7	-6.3	-6.5	-6.8	-7.8	-7.9	-7.3
7000	3	-6.4	-6.4	-5.7	-4.7	-5.3	-5.5	-5.8	-7.1	-7.3	-6.3
7250	3	-6.4	-6.4	-5.7	-4.7	-5.3	-5.5	-5.8	-6.2	-6.3	-6.1
7500	3	-6.4	-6.4	-5.7	-4.7	-5.3	-5.5	-5.8	-5.5	-5.7	-5.6
7750	3	-6.4	-6.4	-5.7	-4.7	-5.3	-5.5	-5.8	-5.5	-5.7	-5.6
8000	3	-6.4	-6.4	-5.7	-4.7	-5.3	-5.5	-5.8	-5.5	-5.7	-5.6
8250	3	-6.4	-6.4	-5.7	-4.7	-5.3	-5.5	-5.8	-5.5	-5.7	-5.6
8500	3	-6.4	-6.4	-5.7	-4.7	-5.3	-5.5	-5.8	-5.5	-5.7	-5.6
8750	3	-6.1	-6.1	-5.4	-4.4	-4.7	-4.1	-4.2	-4	-4.3	-4.3
9000	3	-6.1	-6.1	-5.4	-4.4	-4.7	-4.1	-4.2	-4	-4.3	-4.3

TurboXS UTEC Interface

- Rumor mill reports that TurboXS were working on a software GUI that has *realtime* UTEC tuning capabilities
  - We will just have to wait and see if it ever surfaces

Spare Solenoid Usage



The End

Backup Information – Classic Fuel Tuning

Classic Mode Fuel Tuning

NOT Applicable to OPEN LOOP FUELING Mode

Fuel Map Tuning – 3.1 Default

0% column applies to all RPM's below TPS cross over point (60% by default)

Past cross over point, Throttle > 60%, load is represented by Mass Absolute Pressure, MAP as defined in the SPECIAL CONSTANTS

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
500	-4.8	-7.2	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
750	-4.8	-7.2	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
1000	-4.8	-7.2	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
1250	-6.5	-7.2	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
1500	-6.5	-8	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
1750	-6.5	-7.5	-7.2	-6.7	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2	-6.2
2000	-6.5	-7	-6.6	-6.4	-5.7	-5.7	-5.7	-5.7	-5.7	-5.7	-5.7
2250	-6.5	-7	-7	-6.4	-5.7	-5.7	-5.7	-5.7	-5.7	-5.4	-5.4
2500	-6.5	-7	-7	-6.4	-6.4	-5.7	-5.7	-5.7	-5.7	-4.9	-4.9

Fuel Tuning

- More positive numbers represent more fuel
  - A value of 2 represents more fuel than an value of 1
  - A value of –5 represents more fuel than a value of –6

❖ You are NOT modifying injector duty cycle!

❖ You are modifying the Mass Air Flow, MAF, voltage reading by a percentage

Theory behind MAF based fuel modification

- Fools the ECU
  - A reduction in MAF voltage fools the ECU in thinking that less air is flowing into the engine thus less fuel is required
    - Injectors duty cycle is reduced
  - An increase in MAF voltage fools the ECU in thinking that more air is flowing into the engine thus more fuel is required
    - Injector duty cycle is increased

Why Tune the 0% is using classic fueling mode

- Long Term Trim value used in ECU Open Loop (ECU open loop not UTEC) fuel control
  - Long term value will effect your >63% TPS fuel values
  - If Long Term is not stable, your >63% TPS AFR will never be stable.
    - Maybe too rich or maybe too LEAN

- Short Term always goes to 0 over 63% TPS

The End

Thank you