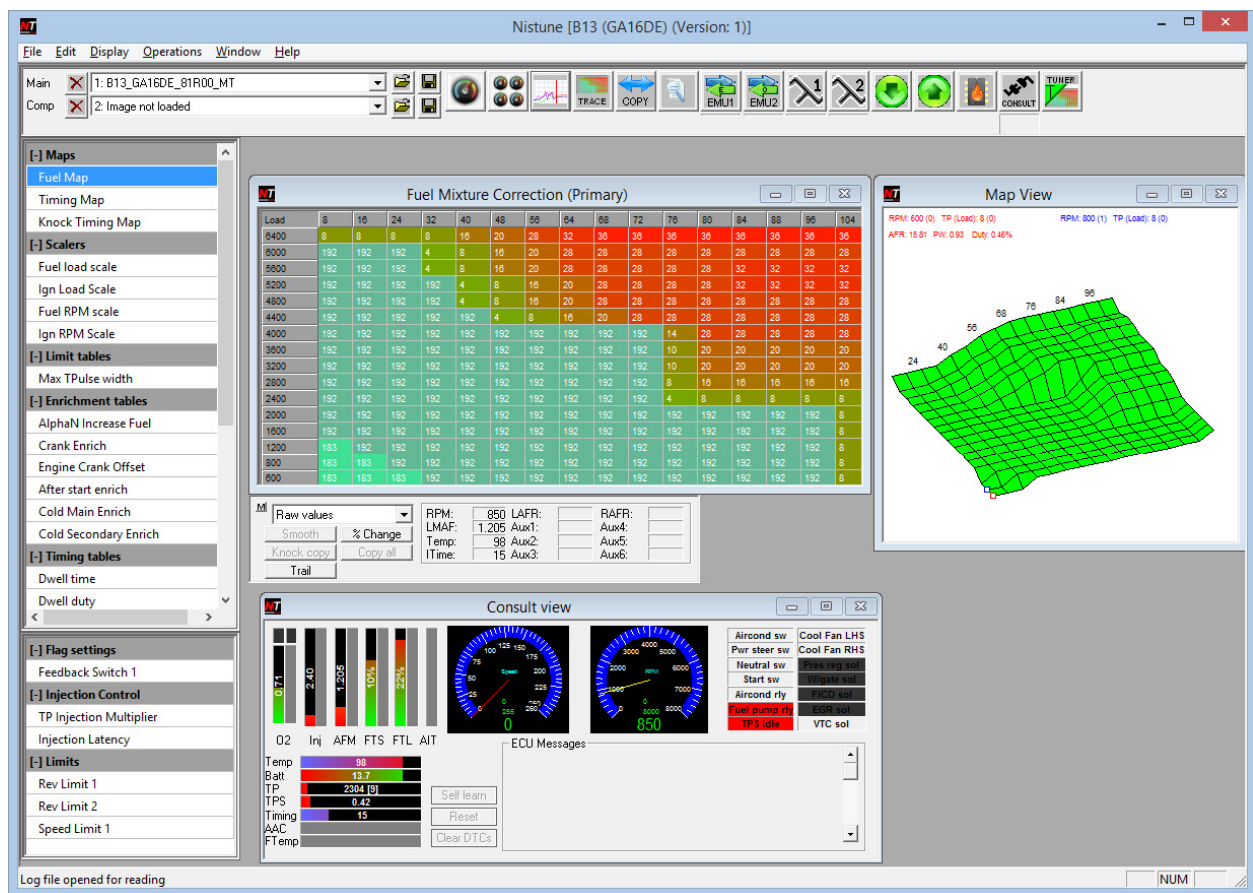


# NISTUNE

## REALTIME ECU TUNING

# MAPPING GUIDE



Version 1.6

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## **Introduction**

This document is intended as a guide to the maps/tables contained in the Nissan ECU, how they are used and what they are used for. This document is a 'living' document which will be continuously updated as more information is discovered and additional maps are found.

Some ECU's are well known and you'll find many different parameters available. Other less common ECU's only have the basic maps/tables available.

Parameters available vary between ECU's. Some older ECU's do not have as many parameters available as newer ones.

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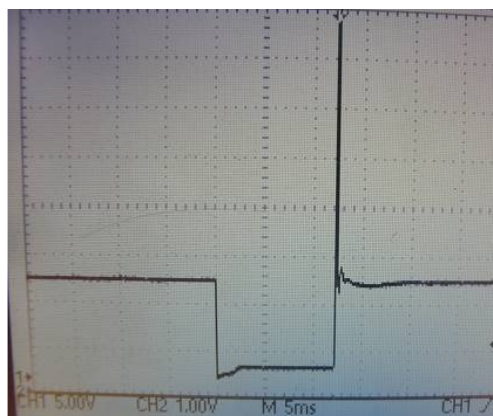
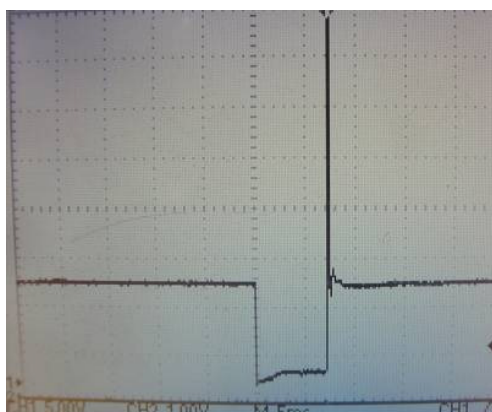
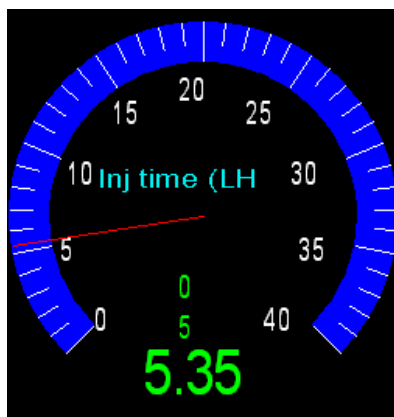
## 1. Fuel Injection

- **Overview**

The injection pulse width is the parameter which determines Air Fuel Ratio measured in the exhaust gas. It all comes back to this. So if in doubt you must always examine the injection pulse width. Usually by taking a log – see Section 7 “Logging”.

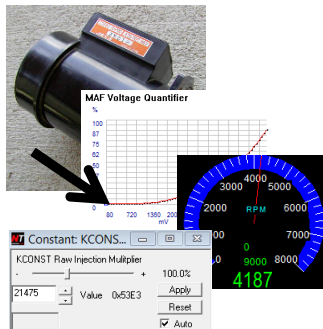
Injection pulse width may be monitored in Nistune using the Consult Gauges to provide feedback on tuning changes

Below is a comparison of the injection pulse width gauge and the actual injector signal measured on an oscilloscope. You can see the correlation in times (squares are in 5ms blocks) when going from 5.35ms to 12.20ms by adjusting the injection pulse width using fuel adjustments.



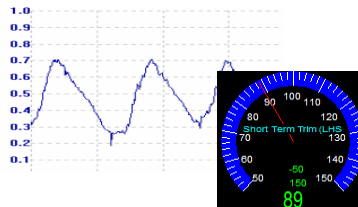
## Calculation of total injection pulsewidth:

Theoretical  
Pulsewidth



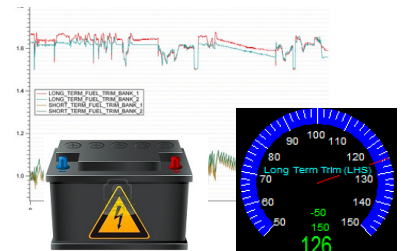
X

Short Term Trim  
(Closed loop)



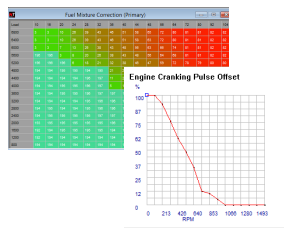
X

Long Term Trim (Stored)

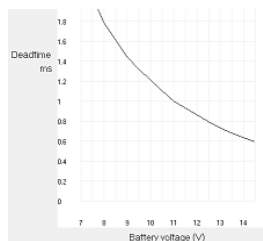


Total fuel calculations

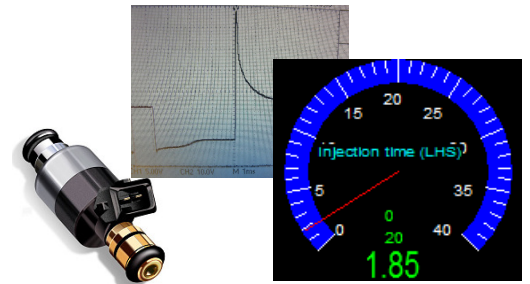
X



+ Injector latency



= Injector Pulsewidth



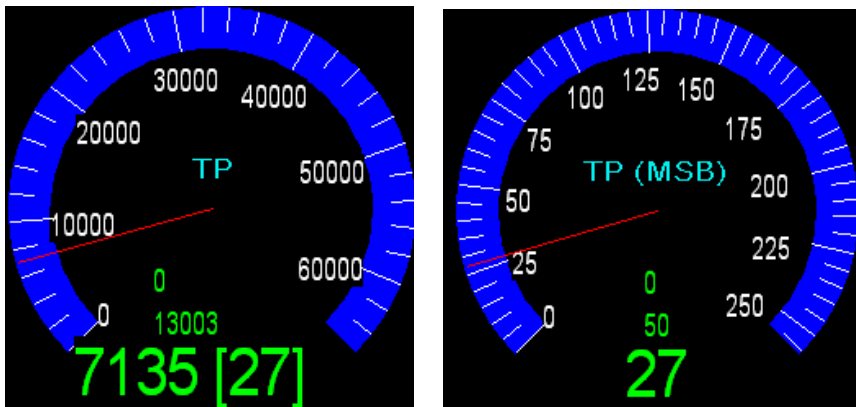
- **Understanding Theoretical Pulse Width (TP)**

There are two references to injector pulse width inside the ECU.

- 1) **Theoretical Pulse width (TP)** – this is an internally calculated figure representing load. This is used for accessing the load columns on the fuel and timing maps. It is calculated from MAF input (VQ) / RPM
- 2) **Injector Pulse width** – this is the physical opening time of the injectors. This figure consists of TP plus whatever corrections are added via the various fuel maps and correction tables.

The two are closely related and understanding both is essential to knowing how to tune the Nissan ECU. Nissan patents available online go into great detail about these pulse widths and how the ECU works but we will focus on the practical side of things.

Theoretical Pulse width inside of Nistune is commonly referred to as 'TP', not to be confused with TPS (Throttle Position Sensor). The value is a largeish number 0 - 65535 as seen in the gauge below:



The main number is the actual TP figure and the second number in brackets is TP / 256. This is known as TP Index, and is used for referring the load position in maps (such as fuel and timing)

TP is measured as the amount incoming air through the airflow meter, offset by the engine speed (RPM)

The basic works of the fuelling side of the ECU are:

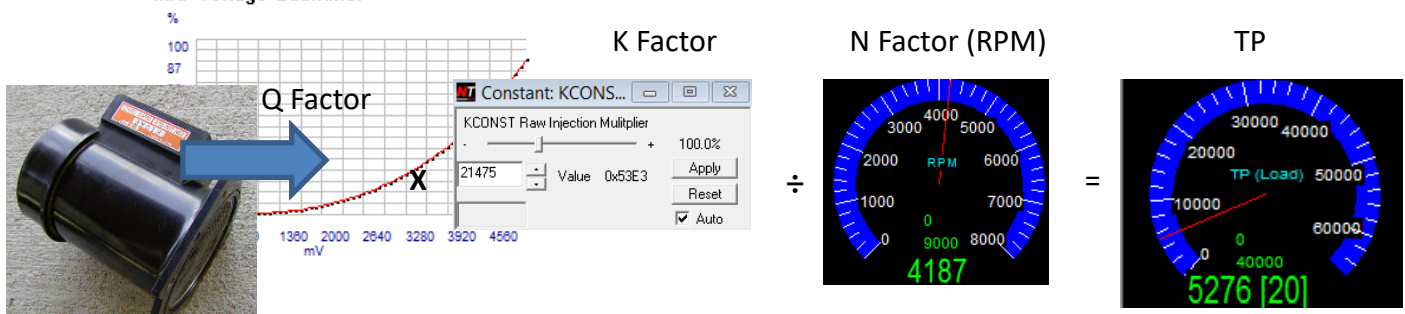
**Theoretical Pulse width (TP) = MAF Lookup (VQ lookup) / RPM \* K Constant**

**Injection Pulse width = Fuel table [ RPM , TP/256 ] \* TP + Injector Latency + Various enrichment**

**Note:** Even with a flat fuel map, injection time will increase as MAF (and TP) rises. Effectively the fuel map just adds trimming to injection calculated from MAF load measured.

**Important note:** If you increase your boost and airflow makes the cursor hit the end of the fuel and timing maps, then it is time to rescale the TP load scales to allow for the extra measured airflow, or lower K constant

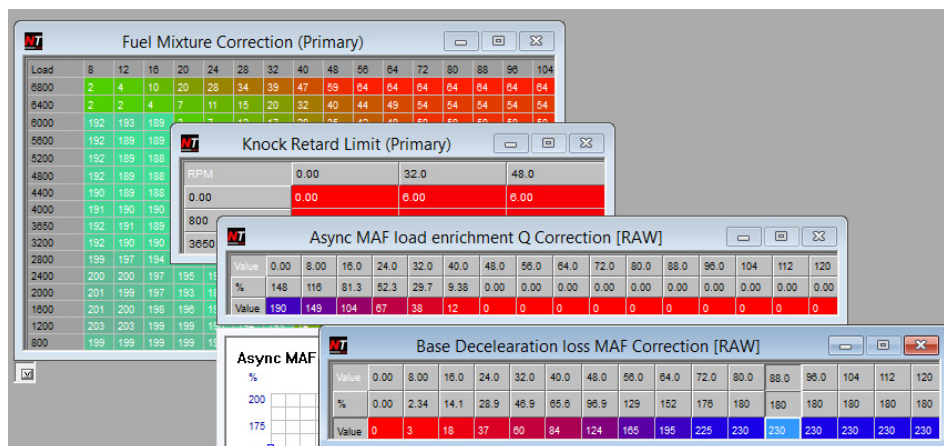
- **MAF Voltage Quantifier**





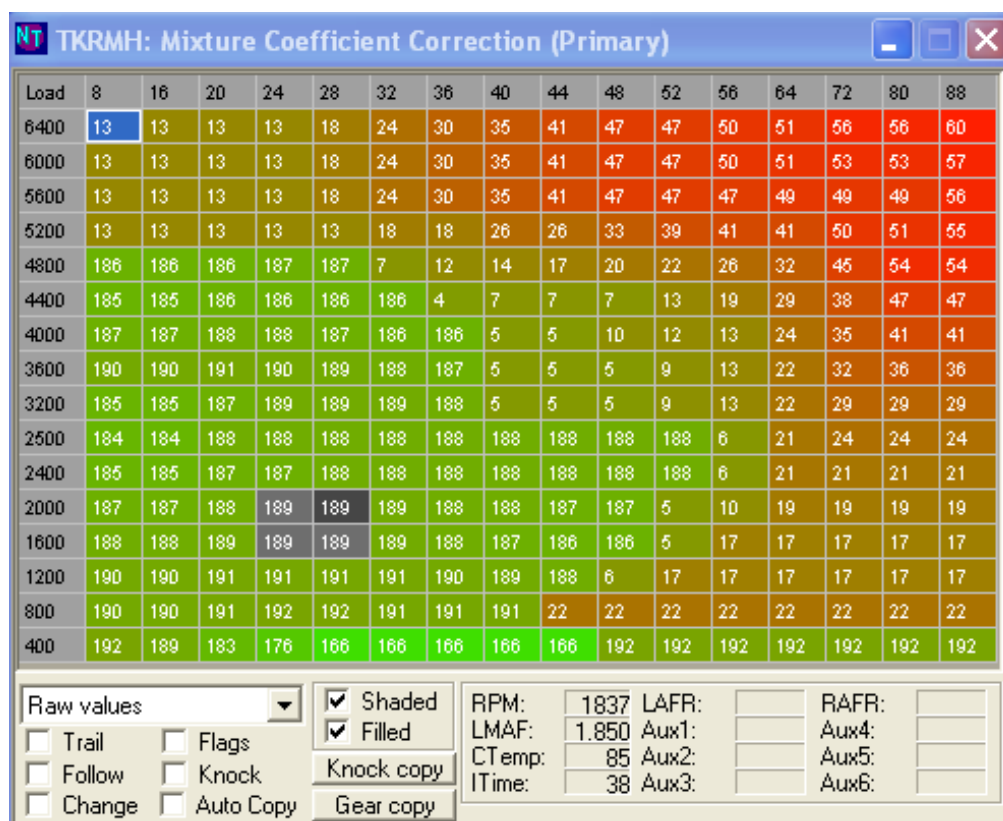
Used to index tables inside the Nissan ECU for fuel, timing, throttle enrichment, knock indexes, VTC etc

Load (TP) index = Load (TP) / 256



Example:

RPM is at 1837rpm and TP = 27. This sits between 24 - 28 on the load scale. We have two trace cursors in the example. These are flickering around where the ECU is accessing the fuel table.



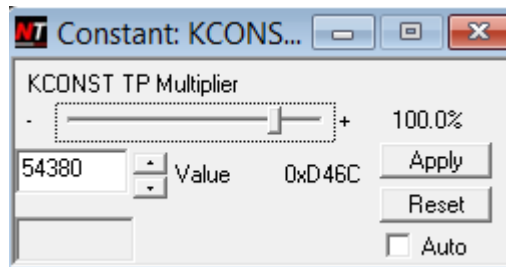
The grey cells are the TP values reported by the ECU. We highlight grey cells to indicate accessed cells and a darker grey cell to indicate closest accessed cell. The calculations for determining the darkest cell are calculated by the current TP and RPM values divided by the weighting of the surrounding lighter grey cells (in this case 27 is closer to 28 than 24 in the TP load scales).

When using hardware tracing (available when using Moates Ostrich emulators) pink cells will display the 4 cells being used to derive the fuel injection from hardware accessing.

TP is used to determine access points for most other load-based tables, as well as calculate injection time for overall fueling.

- **Load (TP) Multiplier (aka K Constant)**

Load Multiplier is the main parameter for changing load scaling, and subsequently injector pulse width. It is one of the most commonly adjusted parameters. This is an overall “gain” figure which will generally affect the injection pulse width regardless of which map(s) is currently being accessed by the ECU.



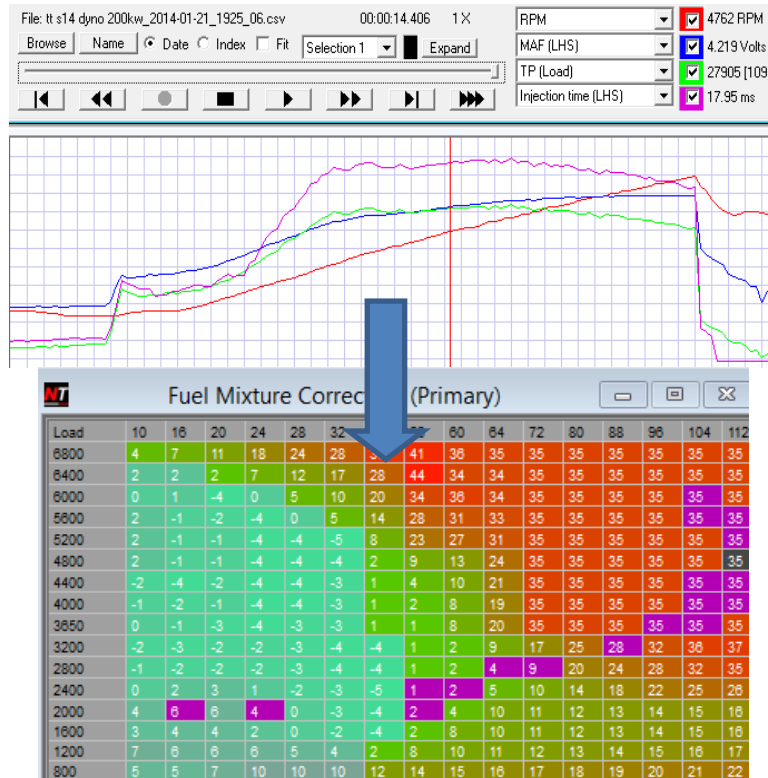
When injector size and/or AFM are changed then the Load Multiplier will be the first parameter to adjust in order to get the vehicle in a basic driveable state – usually just good enough to drive carefully to the dyno.

Changing Load Multiplier, for adjusting final injection pulse width also consequently load indexing used by the same percentage. It is necessary to either:

- (a) Ensure such that the ECU operates within the factory load (TP) scales which is preferable (or)
- (b) Otherwise adjust all available load (TP) scales in affected tables to account for the change due to injector and/or MAF resize in the ECU. This may include tables for:
  - Fuel load (TP) scale
  - Ignition load (TP) scale
  - Min load (TP) for MAF undershoot
  - Max load (TP) for MAF overshoot
  - Closed Loop load (TP) scale for O2 feedback trimming
  - Throttle enrichment (Async MAF, Decel MAF tables)
  - Knock retard limit load (TP) indexes

*Tables available depend on which Nissan ECU you are tuning*

- Adjust the TP scalers based on maximum TP reached. Try to keep all scales close to factory values where possible



### Load scale adjustment

Load (TP) scales are used for fuel, ignition, O2 sensing, knock feedback and acceleration enrichment tables. Not all of these listed TP scales are available in all ECUs.

To minimise changes to TP scales (due to changing K constant) use similar size MAF and injector combinations. For example if a MAF flows 50% extra air then suitably picking injectors which flow 50% more fuel will result in a minimal change to the K constant.

Updated versions of Nistune firmware provide a 'Total Injection Multiplier' to work around this problem, by not needing to adjust TP scales when changing total fuel. Ensure K is adjusted so the vehicle operates within the factory load scales

### Tips for making adjustments:

Use your Fuel Trims (Short Term and Long Term) to work out your final adjustment, with the O2 sensor enabled

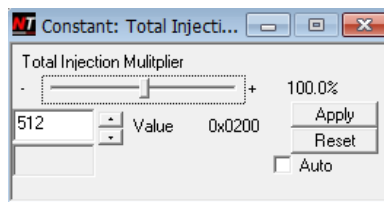
Hold the accelerator of the vehicle at a steady RPM and light load (driving, say 2000rpm, cruising conditions such as about quarter load) when the engine is warm. Make adjustments to your injection multiplier such that the trims gravitate towards 0%

This method will get your K and TIM constant in a suitable position. With no O2 feedback sensor then aim for 14.7:1 when using standard fuel.

- Total Injection Multiplier (aka TIM)**

Total Injection Multiplier (TIM) is an additional parameter added specifically to Nistune programmed ECUs available in selected vehicles in boards programmed from Nov 2014 onwards.

This parameter adjusts the injection pulse width without affecting vehicle load. Adjust K constant to keep the load within the ranges in the fuel and timing maps, and adjust TIM to normalise your total fuelling.



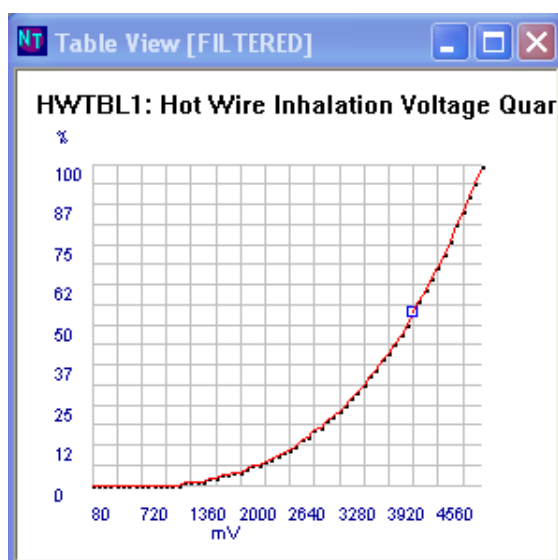
- **VQ Map (AKA MAF Translation)**

The Mass Air Flow Meter (MAF or AFM) is a sensor which uses a hot wire to measure the amount of air entering the engine. The MAF will attempt to keep the hot wire at a specific temperature as airflow across it varies. As airflow increases it will consume more current to keep the wire at temperature. This current is converted into a voltage and this voltage then represents airflow. This is the primary input used by the ECU to determine injector pulse width along with RPM

This table converts airflow voltage into the base TP (load) value used by the ECU.

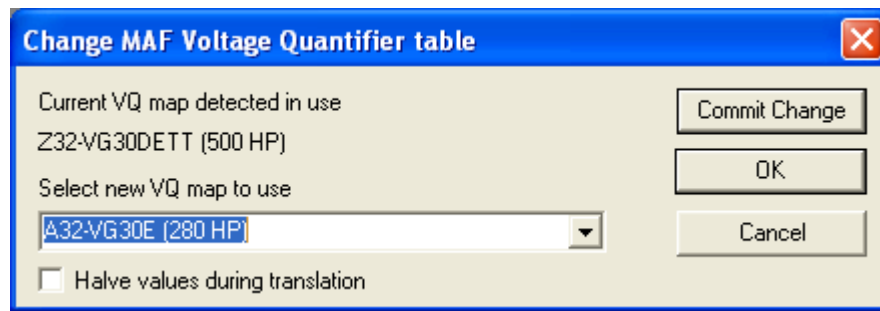
*Note: R32 GTR ECUs with twin AFMs will use this table twice (so the values in the table are half the range of other Nissan ECUs)*

mV	3920	4000	4080	4160	4240	4320	4400	4480	4560	4640
%	41.9	44.7	47.7	50.8	54.1	57.4	61.0	64.7	68.5	72.5
Value	27472	29324	31267	33305	35432	37648	39977	42404	44923	47544



AFM voltage is typically 0 - 5 volts. The ECU then uses this voltage to reference points in a lookup table which represent load percentage. This lookup table is called the Voltage Quantifier (VQ) map and is effectively a calibration curve for the AFM. Each different AFM has its own specific VQ map, so if the AFM is changed then the VQ Map must be changed to suit. The AFM voltage and the VQ Map are critical parameters and will have a drastic affect on tuning.

*Note: VQ maps are changed in Nistune using the dropdown menu under "Operations, Change Mass Airflow Meter". Approximate maximum HP readings are shown and used for the adjustment of the Injection Multiplier - this is a simple ratio of old vs new AFM HP rating. Remember though that these are theoretical numbers - always check the actual resulting AFRs and then adjust the Injection Multiplier as required. Refer to the Tuning Basics Guide for more info.*



Nistune dialog box used to change AFM VQ Map.

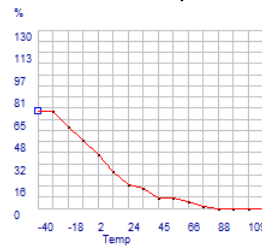
- **Total Fuel Calculations**

Fuel calculations are a sum of the standard fuel map, plus various enrichments:

Load	10	18	25	34	43	51	58	65	72	80	87	94	102	109
8000	3	3	10	20	30	43	48	51	58	65	72	80	81	82
5400	3	3	10	20	30	43	48	51	58	65	72	80	81	82
5000	3	3	7	13	25	38	43	48	55	63	74	81	81	82
5000	195	195	3	3	20	30	39	43	48	55	64	68	71	75
5200	195	195	3	3	18	21	32	38	43	50	57	72	75	79
4800	194	194	195	195	194	195	21	25	38	44	62	65	70	75
4400	194	194	194	194	194	197	19	22	27	34	39	55	67	71
4000	194	194	195	195	195	197	5	16	21	29	34	48	59	62
3600	194	194	195	195	195	197	197	199	199	21	31	43	53	55
3200	194	194	194	194	195	195	197	197	199	19	21	34	45	47
2800	194	195	194	194	195	195	197	197	199	19	20	25	34	35
2400	194	195	195	195	195	197	197	197	199	19	20	24	24	25
2000	193	195	195	195	195	195	196	196	196	12	16	17	17	18
1600	192	194	195	195	195	195	194	194	194	10	12	13	13	13
1200	192	194	194	194	194	194	194	194	194	4	4	4	4	4
800	194	194	194	194	194	194	194	194	194	4	4	4	4	4

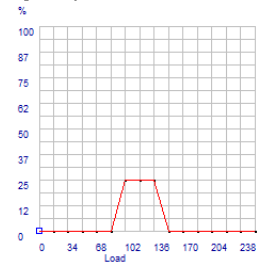
Fuel values

Enrichment coefficient (Idle, Cold crank)



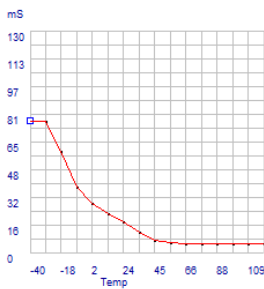
Warmup Temp  
Enrichment  
(Not closed loop)

High Temperature Offset vs TP

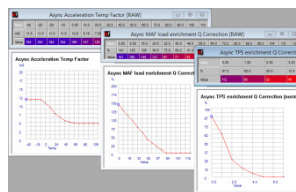


Over temp  
enrichment

Crank Enrich

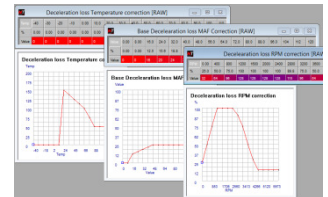


+



Accel Enrichment

-



Decel Enrichment

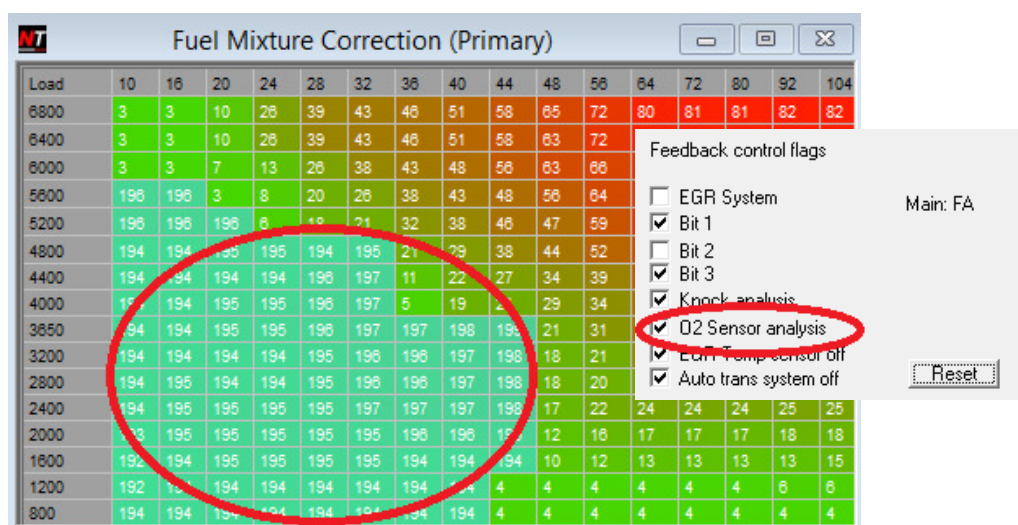
## Earlier Vehicles: Main Fuel Maps

Fuel map figures make further adjustments (effectively trimming) on top of the Injection Multiplier and Latency. Being a 3D map, they allow adjustments based on load (TP) and RPM.

Once you have the correct MAF selected (VQ map calibration) and your base mixtures have been set (at cruise around quarter load and 2000rpm) using TIM (total injection multiplier) and K Constant (total load multiplier), then this where the majority of tuning time is spent.

Fuel map access may be conditional on multiple factors including:

- Engine Coolant Temperature
- O2 feedback mode (closed loop)
- Throttle Position Sensor input
- Gearbox Neutral Switch



Fuel maps effectively add extra trim to the base MAF calculated mixtures in Nissan ECUs. Base mixtures must be correctly setup firstly before adjusting fuel. Larger injectors flow more, and will result in flatter fuel maps.

Note: Nissan ECUs only calculate injection pulse width. They do not have a concept of AFRs

Most later model ECU's have two fuel maps. These are referred to as "Primary" and "Knock" maps (or High and Low Octane maps based on the map used, dependent on used fuel type).

Primary map is used unless a certain amount knock has been detected, and then the ECU will switch and lock onto the second map. *The low octane (knock) maps have been removed in Feature Pack updates, so you may not see these, but knock timing retard is still fully functional*

Knock maps tend to be richer than Primary maps to help alleviate knock when it is detected. Earlier model ECU's will only have single fuel and timing maps. They do not have knock maps like later types.

Nistune has implemented indications of which maps are currently being accessed:

Maps
Fuel Map
Knock Fuel Map
Timing Map
Knock Timing Map

Supported ECU's have maps highlighted in **green** to indicate the current map being used by the ECU. For other ECU's it will be necessary to use feedback from adjustments made to the fuel maps to determine which map is currently being accessed.

Fuel maps have an embedded O2 sensor flag within them (raw value + 128 indicates O2 flag used). When these cells have the O2 sensor flag set, the ECU will attempt to maintain “closed loop”. Which means that it will adjust mixtures aiming for 14.7:1 based on feedback from the O2 sensor. Refer to the section on “O2 Sensor Feedback” on page 40.

The value range for the fuel map is arbitrary and set by Nissan. There is no direct correlation between the ‘filtered’ map numbers and air fuel mixtures. What we do know is the combination of the K Constant and the default ‘filtered’ numbers in the map are set to what Nissan intended for factory mixtures of their vehicles, and to pass emissions testing.

The ranges in the fuel map allow for negative numbers when the O2 sensor flag is enabled, but can only be set to positive numbers when the O2 sensor flag is disabled.

**Note:** Some vehicles have been modified using ball bearing turbo charges which keep on spinning after boost. If the MAF is too close to the turbo, this can result in airflow being sucked through the MAF whilst RPMs are dropping.

Unfortunately, this can result in over rich conditions as the TP keeps increasing as a result, and you will note this by the trace cursor going across the bottom row. If this occurs, try and rectify the issue by increasing the bend and distance between the MAF and turbo. Otherwise you may be able to reinstall the MAF post intercooler.

Another option is to introduce negative numbers on the lower row(s) of the fuel map to reduce injection time, whilst the TP load keeps increasing. Also consider lowering the lower end numbers of the TP max table, to limit calculated injection time.



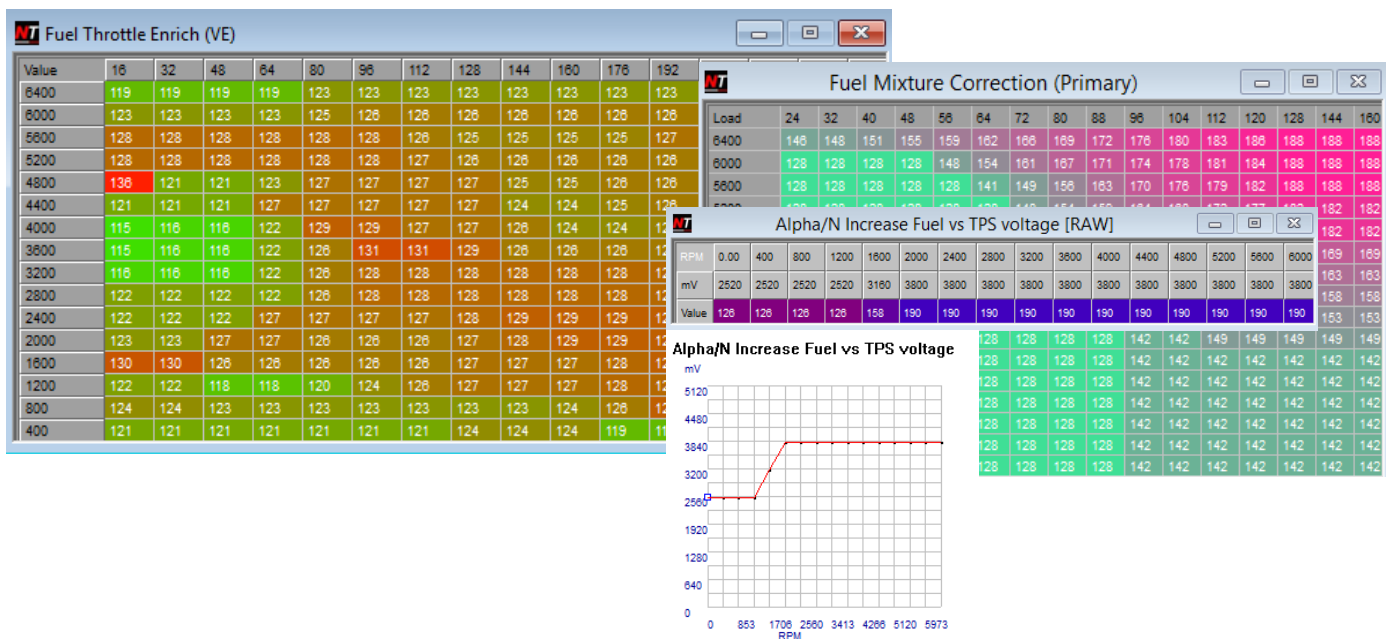
## Later Vehicles: Fuel and Throttle Enrich (VE) Map Values

Later model ECUs split the two coefficient scans into separate tables, replacing previous throttle enrichment tables

- **Fuel Map (First scan coefficient):** Fuel table is read (all raw values > 128)
- **Throttle Enrich (Second scan coefficient):** Used when the TPS is below the Alpha/N limit the volumetric efficiency. Referenced value is added to fuel map value. Indexed by **Adjusted TPS (ATPS)**. This map replaces throttle enrichment tables that were available in earlier model Nissan ECUs

The **Throttle Enrich (VE)** map should be treated as a throttle enrichment map, *not* used to aim for target mixtures. It replaces the throttle enrichment maps which were available in the earlier model Nissan ECUs

Note: **Adjusted TPS (ATPS)** which is calculated from TPS (and boost sensor, where available) is used to index the VE map. If you do not see horizontal tracing, make sure this parameter is selected in your Consult Register list.

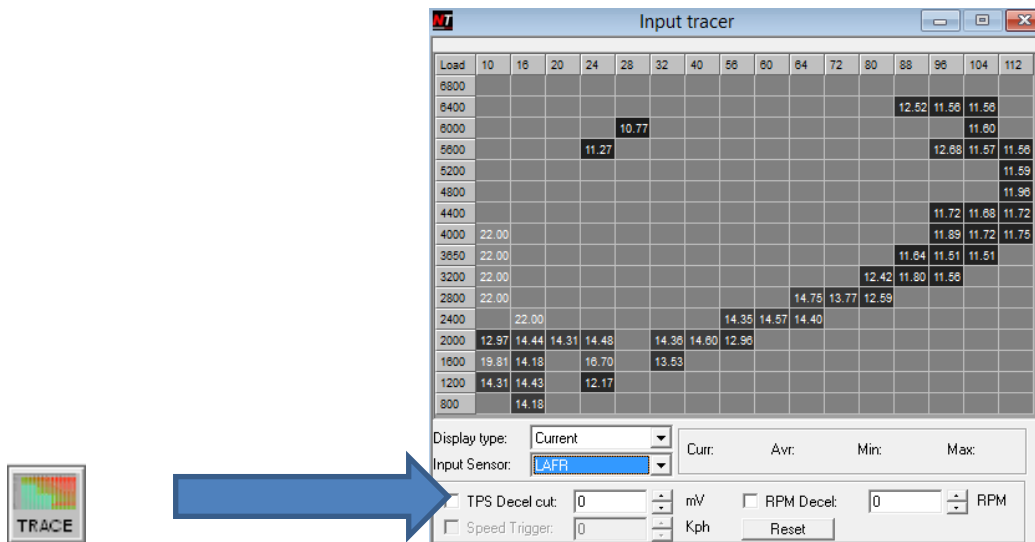


## Smart AFR Monitoring

Given the ECU does not 'know' the resulting AFRs that are commanded from the combination of the K constant, TIM, fuel map and other enrichment factors, a wideband is necessary.

Hooking a wideband into your laptop and integrating with Nistune can trace your AFRs on your laptop screen

Use the 'Trace' icon to select your sensor (LAFF for wideband) and see your AFRs, injection time, ignition timing etc, trace against your fuel map. Boost etc can also be monitored using this technique with suitable input devices

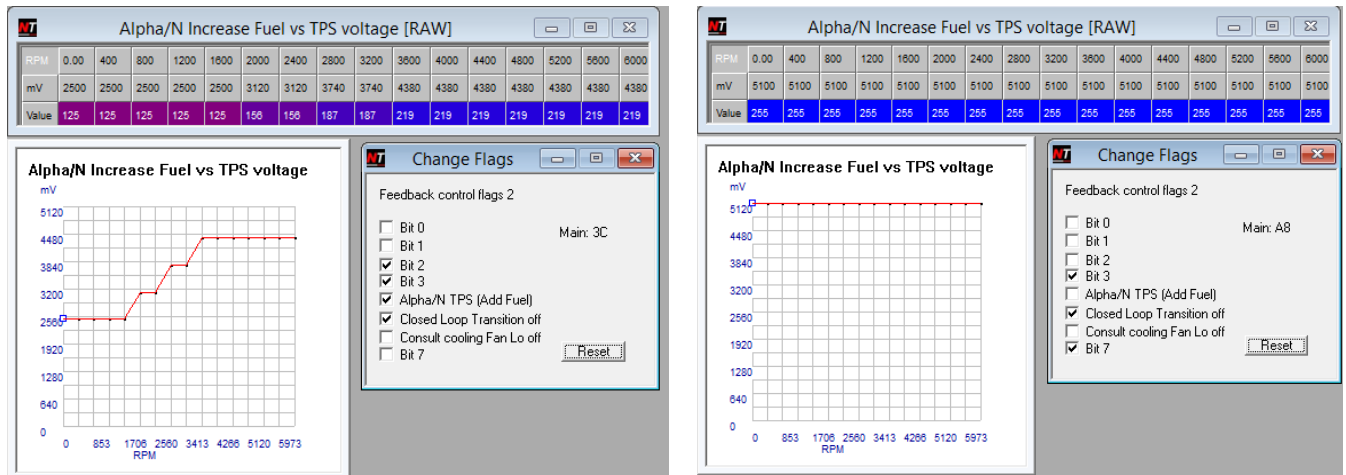


## Alpha/N Increase Fuel vs TPS voltage

### Summary:

This table is used indicate the TPS voltage required to force use of the last column of the fuel map. Used to set the 'TP' indexing to maximum value (of 255) effectively

It is the equivalent of setting the load cursor artificially to full throttle once the desired TPS value has been exceeded. Most early model turbo ECU will have this TPS voltage value set above maximum throttle position (on boost this table is not used)



*Note: that this TP value will not log/display inside Nistune as the ECU only calculates this internally.*

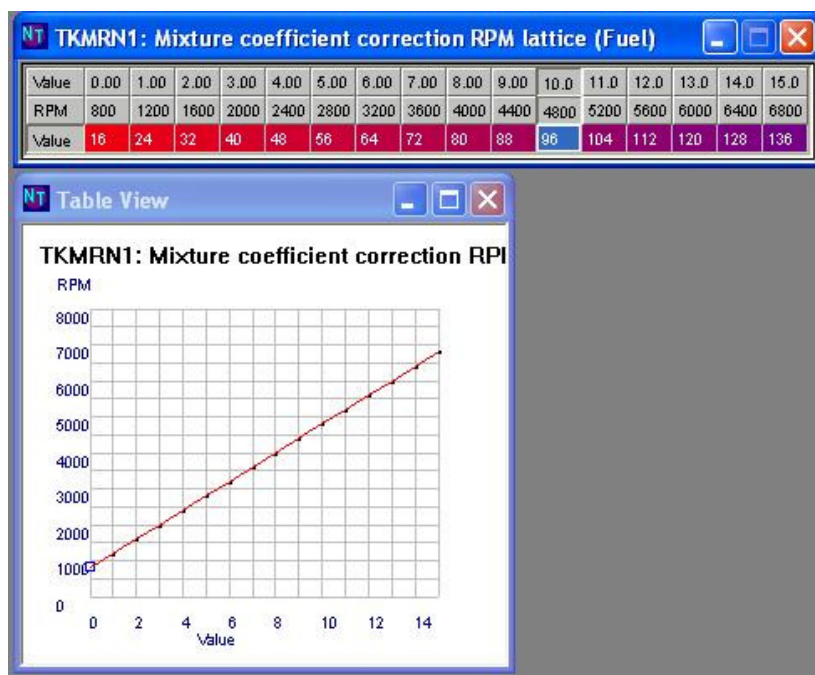
*Note: Updates to recent versions of the Nistune software will display a RED trace cursor on the screen when this table is used.*

- Full throttle position is determined by the Alpha/N (Accel Increase Fuel Table). This is used by default in non turbo vehicles to access the last column of the fuel map.
- Turbo charged vehicles with no VE maps should disable this flag or setting the map to maximum TPS voltage (raw value = 255)

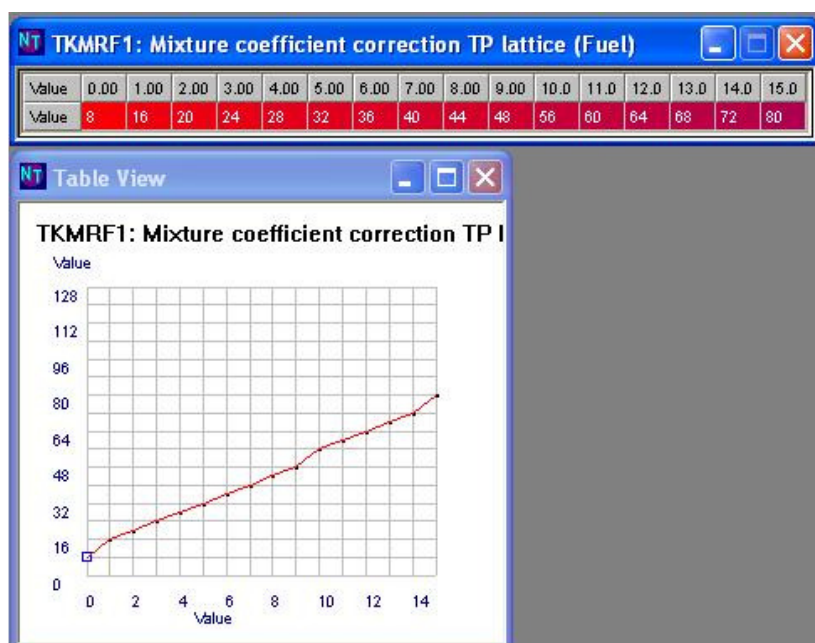
## RPM/Load Scales

Edit by selecting a value in the table and use +/- keys to adjust. Use left/right arrow keys to move right/left. The scale is usually kept linear, or pretty close to it. Adjustments are in 50 rpm increments.

Direct editing is only available in 'raw view'. The view type can be changed by right click 'Filtered values'



Load Scales are adjusted using the same method as Fuel Scales but can take a little more work to get right. These scales are widely known as "TP scales" in the Nissan tuning world.

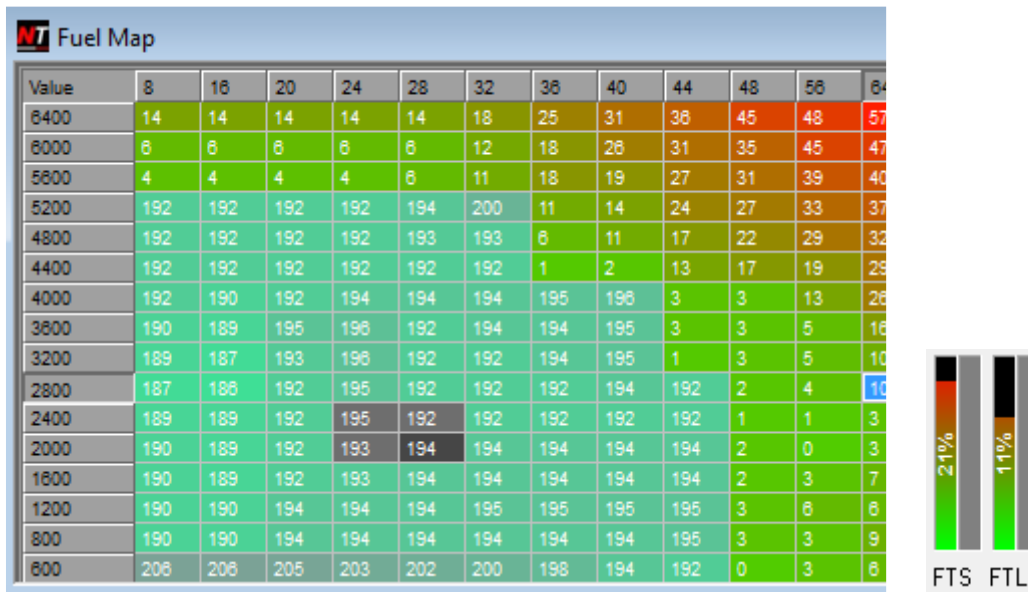


The values in these tables are an arbitrary figure – they do not directly represent vacuum/boost. When airflow is increased (ie: boost increased) and/or injectors/AFM are changed then Load Scales will need to be adjusted. Refer to *Nissan ECU Tuning Basics* document for more on this.

When tuning feature pack ECUs, attempt to keep standard factory load scales. Adjust K constant to adjust TP in order to access the full load range of these tables, and adjust TIM to obtain correct overall fueling.

## Closed Loop (RAM map) RPM/Load Scales

Closed loop trimming works by adjusting both STFT (short term **FTS**) and LTFT (long term **FTL**) trims within the O2 feedback area (aqua highlighted area below).

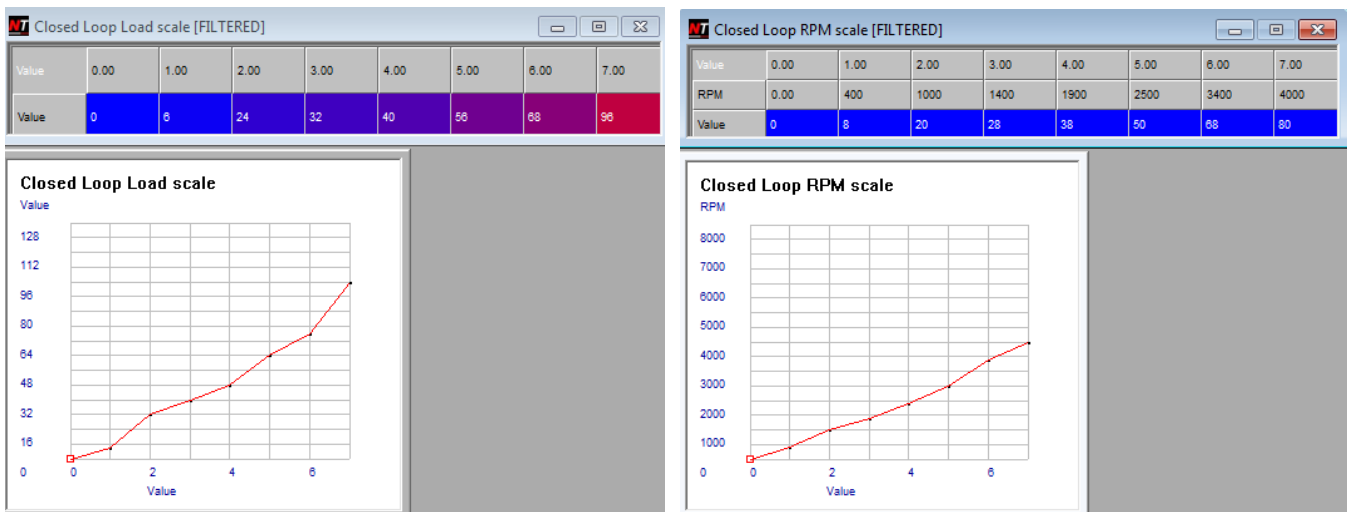


Outside the closed loop area, FTS will reset to 0% and the ECU will hold onto the values within the long term trim, until outside the closed loop TP (load) and RPM ranges.

### Internal trimming map

An internal 8 x 8 cell map held in memory (RAM) of the ECU is updated with narrowband closed loop trims whilst in closed loop. If adjusting K constant, the tuner map find that the area being held onto in closed loop continues outside the normal highlighted (flagged) area.

Adjust the load and RPM scales of the closed loop RAM tables to adjust for differences with K constant (where available for your ECU)



## Load (TP) min / max – Total TP injection limits

Nissan ECUs have load limits (clamping) in place. These are used for MAF voltage stabilisation.

*Note: These tables are not available in all Nissan ECUs. Later Nissan ECUs with Throttle Enrich (VE) maps will not use TTP min tables (and some models do not have TTP maximum tables either)*

These tables provide absolute limits for upper and lower load. They are used to prevent undershoot of MAF voltage (on deceleration) and overshoot of MAF voltage (on acceleration). When K Constant is adjusted to cater for larger airflow meters and/or injectors and the TP is consequently affected, then may need changing to accommodate for the different TP range based on percentage of movement of K constant.

Larger injectors flow more fuel in a given time period. Hence the K Constant needs to be modified (lowered) when upgrading to larger injectors. This results in a lower TP value in both tables

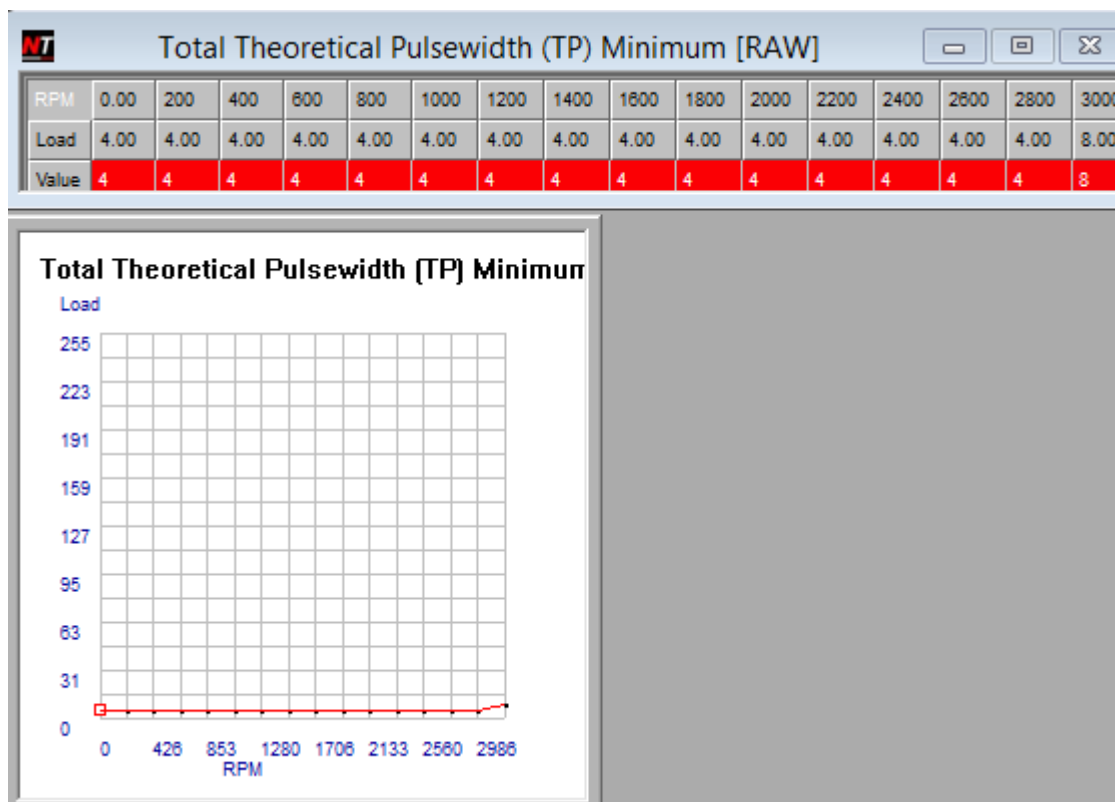
The two tables which control this are TTPmin (Total Theoretical Pulsewidth min) and TTPmax (Total Theoretical Pulsewidth max).

### Min Load (TP) - TTPmin

Min Load (TP) is the lowest TP value allowed after reading the MAF voltage and converting to TP. When adjusting K constant, this table may need to be adjusted accordingly (eg. smaller K, reduce this table lower by similar percentage)

When to use: These values can also affect idle mixtures, so if idle is too rich (and cannot be adjusted) then reducing values can help. If your MAF voltage dips too low, then increase the TP to avoid under fueling.

*Note: This table has no impact on minimum TP indexing used with fuel and timing maps*



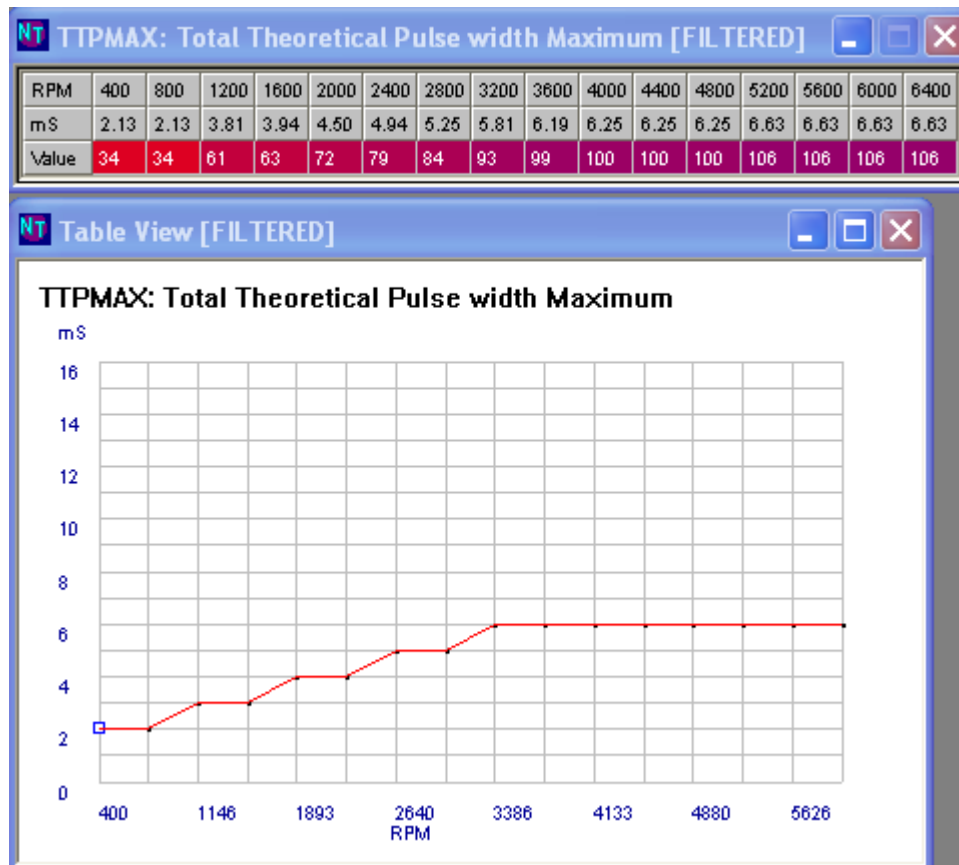
## Max Load (TP) - TTPmax

Max Load (TP) is the largest TP load index value allowed at a specified RPM. If you find that mixtures do not increase enough at high load then the factory values used by this table may be limiting the maximum TP load input, and hence your injection time will not increase further,

How to use: Normally you would need to increase the top end table values (typically on high boost applications)

You can also adjust Max Load (TP) at the lower end to assist in avoiding overfueling on deceleration, by clamping TP. This will assist in preventing TP (and injection time) increasing at lower RPMs

*Note: This table will not limit load indexing to fuel and timing maps in most ECUs.*



## TTP min/max Auto Adjust

When using the "Resize Injectors" facility in Nistune, enabling the check box (recommended) will cause Nistune to adjust these tables using a ratio of old vs new injector size.

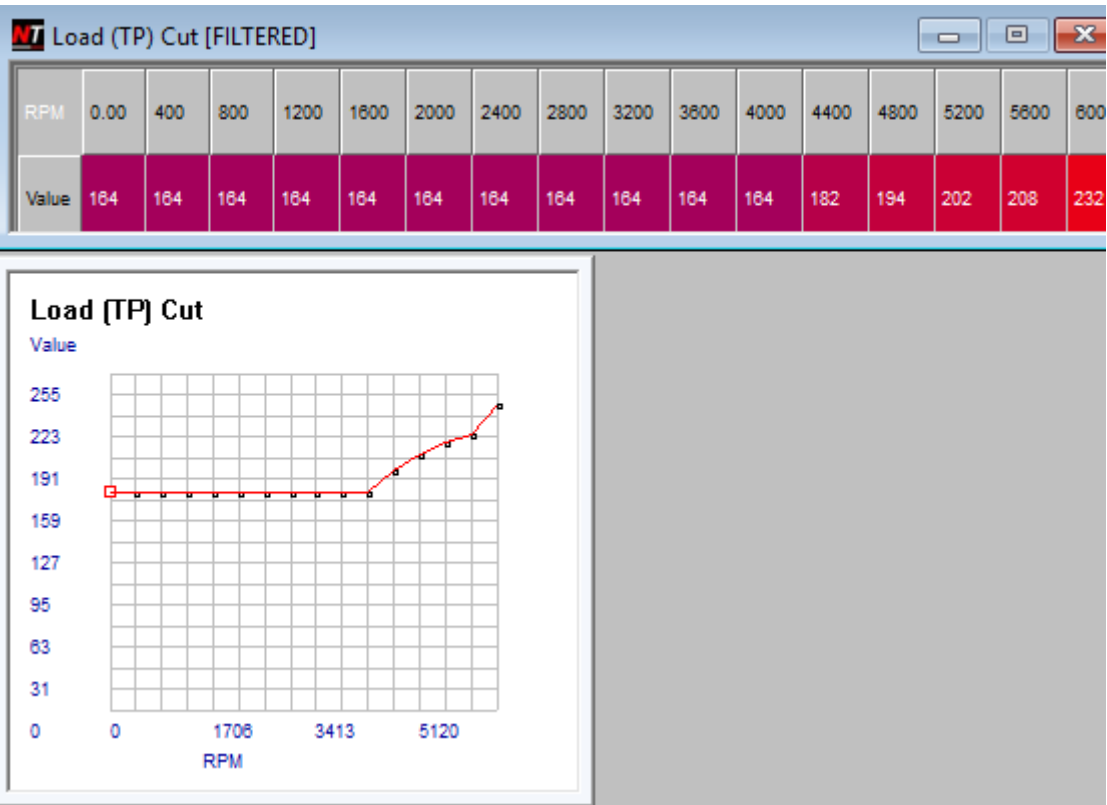
The screenshot shows a dialog box titled "Resize Injectors". It contains a section for "Injector CC => Injection multiplier" with two rows: "Current" (440) and "New" (750). The "Value" for the current injector is 233 (0x00E9), and for the new injector, it is 136 (0x0088). Below this, there are three checked checkboxes: "Adjust TP (load) scalars", "Adjust TP Max limit", and "Adjust Cranking Tables". At the bottom right, there are three buttons: "OK", "Cancel", and "Factory CC".

# TP Load Limit/Recovery (Fuel Cut)

## TP Load Limit

This is a form of limiting based on TP, also known as “Boost cut”

*Note: NEO ECUs will also have a Boost sensor cut table. This will instead use Boost limit tables using the boost sensor. Up to a maximum of 5.12 volts (18psi). If the boost sensor is disconnected, then it will instead use the TP limit tables. Refer to the NEO tuning document for more information.*



If TP goes above the values in this table (for given RPM) then the ECU will start a counter and after a period of time perform a fuel cut. This is a protection mechanism provided by the Nissan ECU for when the engine over boosts due to problem with controlling the waste gate actuator. Values in this table are often increased to allow higher boost levels.

*Note: TP will increase as boost increases. So values in the TP Load Limit table will need to be increased. Some tuners set to 255 which will allow for maximum TP to be reached but this then removes any form of overboost protection.*

## TP Load Recovery

After a fuel cut has occurred, fuel injection resumes once TP has gone below the limits specified in this table.

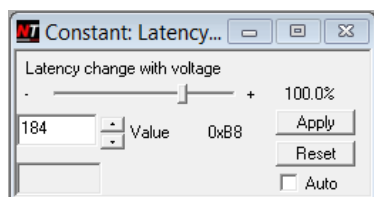


## Injector Latency

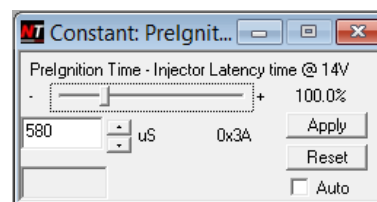
Injection latency (sometimes known as “void time”) is the opening / closing lag time of the injector. Bigger injectors need more latency to compensate for the increased opening / closing time.



X

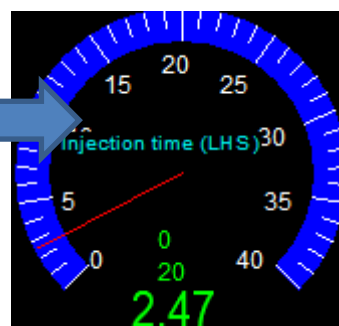
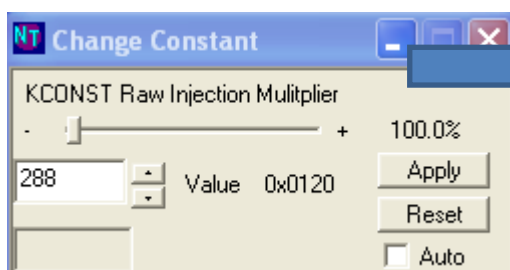


+

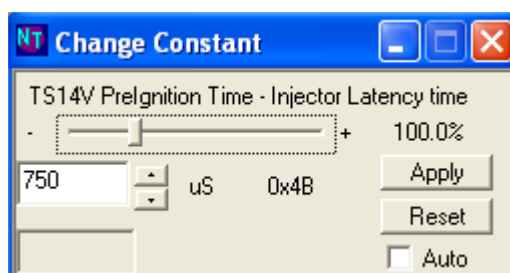


Battery Compensation  
(14V – current voltage)

This will increase the Injector Time seen on the gauge by the amount entered in this box.



Note that the latency times are in 10us steps inside the ECU. So if you select 751 us for example it will still report raw value of 0x4B. You need to increment in counts of 10us (for example next step 760us will change the ECU byte to 0x4C).



Webber's injection guide (available on the Nistune forums at [forums.Nistune.com](http://forums.Nistune.com) in the miscellaneous section) contains a list of common latencies used with Nissan ECUs. Always be careful to check the voltage that any latency figure is specified for, as latency is affected by voltage. You need to find the required latency time at 14 volts (the standard operating voltage of a vehicle).

Adjust latency to trim idle/low load mixtures (there is no separate idle mixture table in Nissan ECUs). Feature pack 2 ECUs have removed this parameter and replaced with a table in the 'Fuel maps' section.

## First Time Enrich

### Summary:

This table will adjust injection pulse width during cranking based on coolant temperature.

### Reporting:

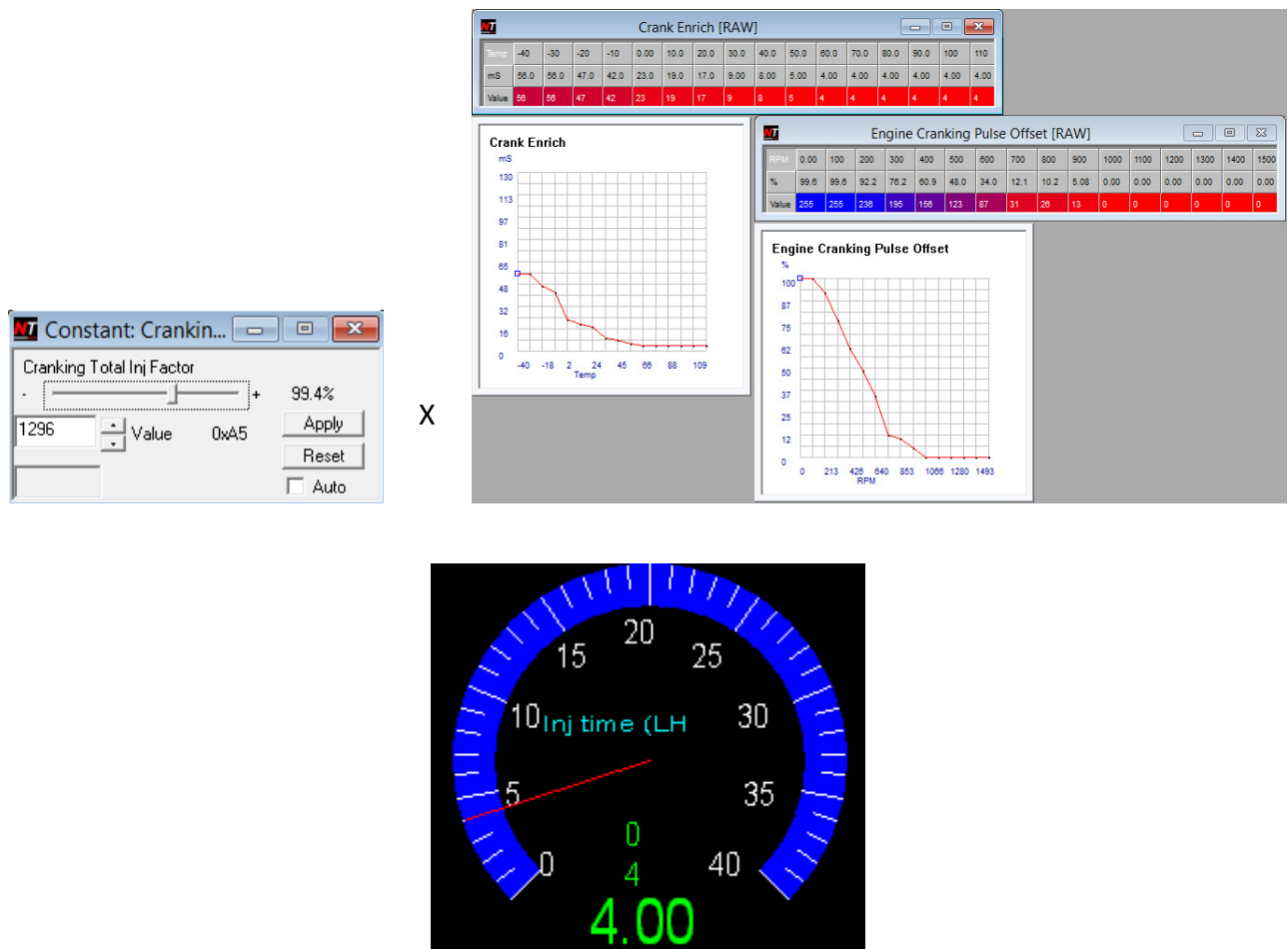
The map trace cursor will highlight the target pulse width in ms. This value should match the number displayed by the Inj Time gauge. The example shown uses 4 milliseconds for injection pulse width during starting.

### Conditions:

The First Time Enrichment map is accessed when the Start input **Start sw** is used during cranking and subsequent starting of the engine.

### Note:

Decrease cranking tables or cranking factor when resizing injectors to prevent overfueling during cranking



## After Start Enrich

### Summary:

Similar to First Start Enrichment. When the engine is cranking, this table will be used to determine the amount of extra enrichment based on temperature. It is percentage based rather than actual milliseconds.

This table can be viewed as an equivalent of an electronic choke. Colder temperatures will have more enrichment to get the engine started.

### Conditions:

This table is only used during starting when **Start sw** is active. Once engine is running it is no longer accessed.



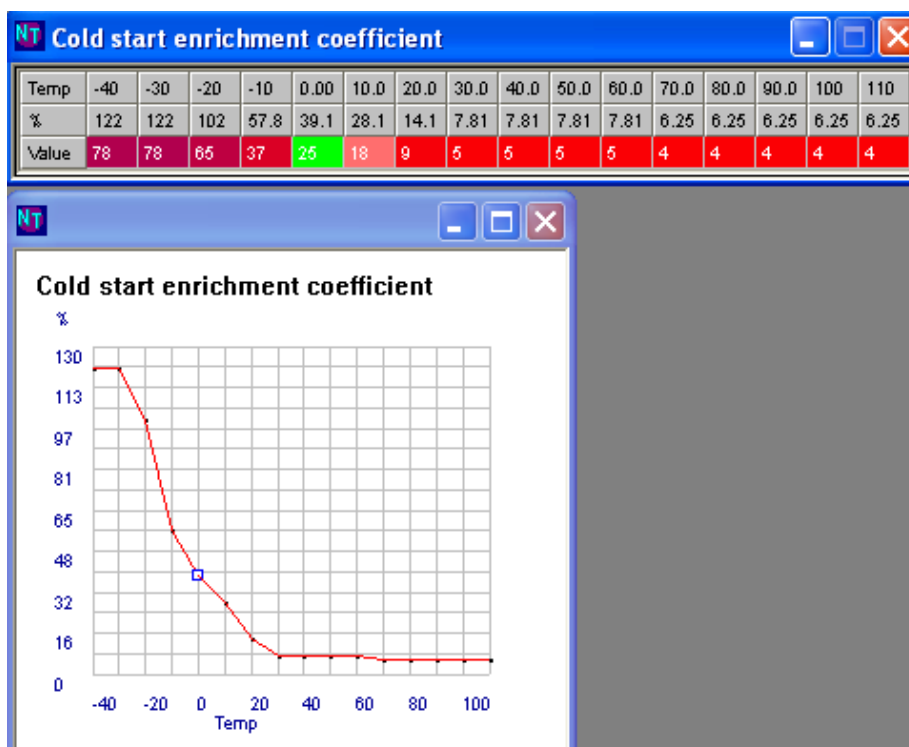
## Cold Start Enrichment Coefficient

### Summary:

This table adds an additional percentage of fuel based on coolant temperature after starting. The ECU injects more fuel when the engine is cold.

### Conditions:

This table is accessed during cold starts after the **Start sw** is used during cranking and for about 5 seconds following starting of the engine.



## Warm Start Enrichment Coefficient

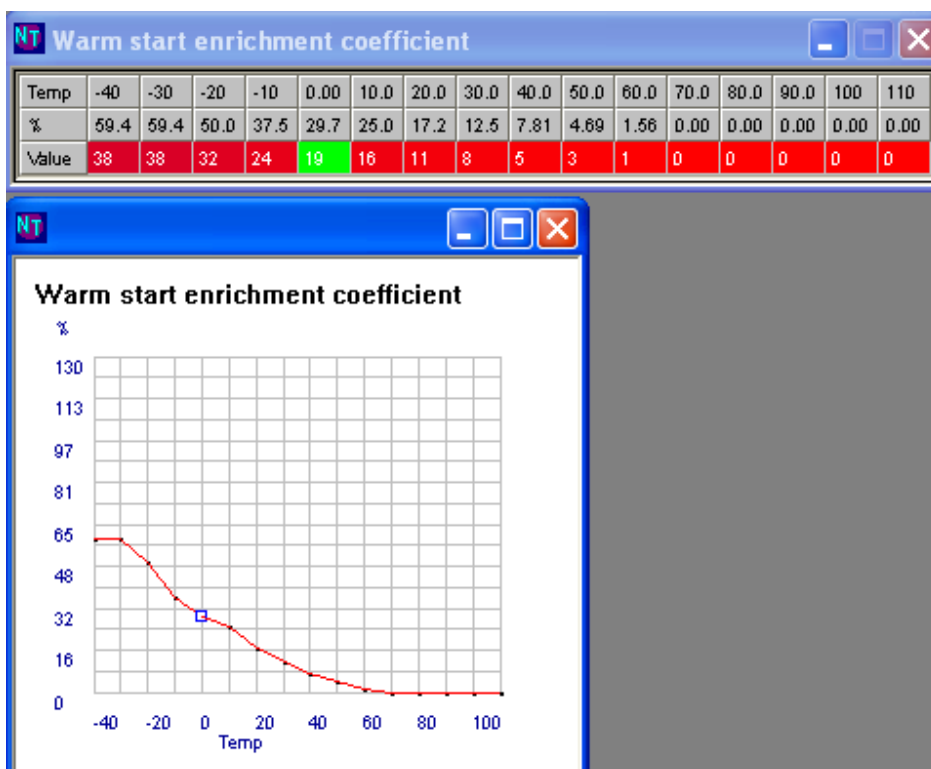
### Summary:

This table uses the coolant temperature to determine fuel injection coefficient for final pulse width adjustment during warm starts.

### Conditions:

It was noted during bench testing (on HCR32 ECU) that this table was not accessed with any various starting, TPS or neutral switch positions. It is assumed this table would be used after Start switch indication has been received.

Enrichment reduced as engine speed exceeds 2000rpm. Number of tables vary between vehicle type. Earlier models have a single table, whilst later models have throttle and crank temperature specific tables



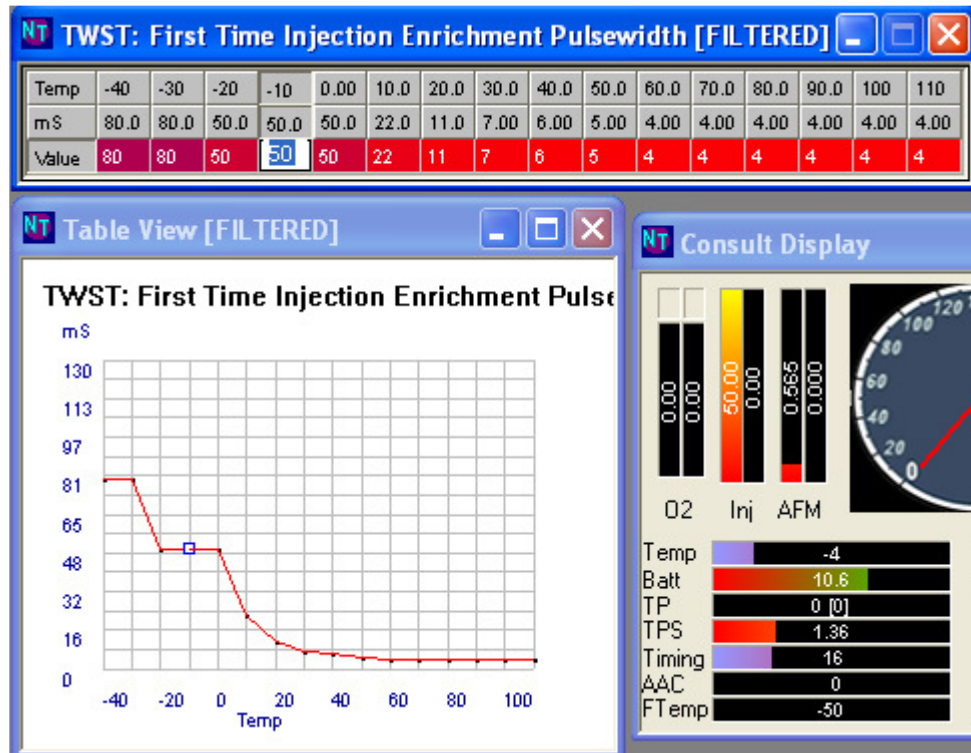
## First Time Injection Coefficient

### Summary:

Determines the amount of ms to inject based on coolant temperature. Notice in the example that the 50ms in the table matches the 50ms of injection time reported via consult. This table represents the exact pulse width injected during start switch usage.

### Conditions:

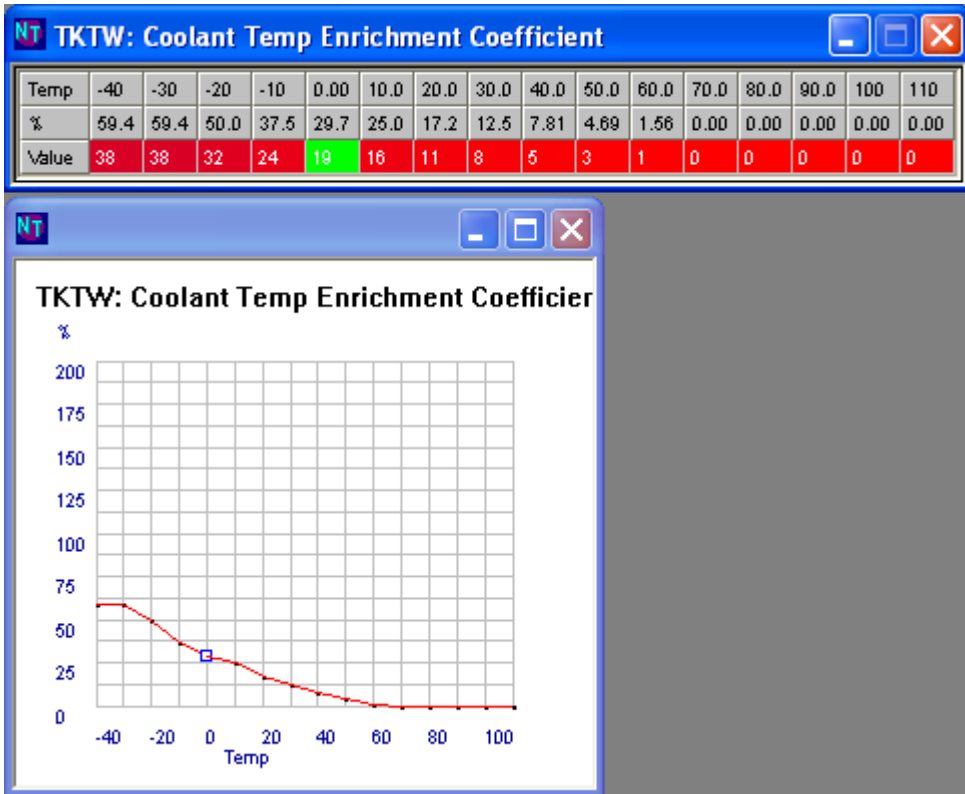
This table is used when the Start sw start switch is activated during cold starting.



# Coolant Temperature Enrichment Coefficient

Summary:  
This table uses the coolant temperature to determine fuel injection coefficient for final pulse width adjustment.

Conditions:  
It was noted during testing (on HCR32 ECU) that this table was not accessed on bench with any various starting, TPS or neutral switch positions.

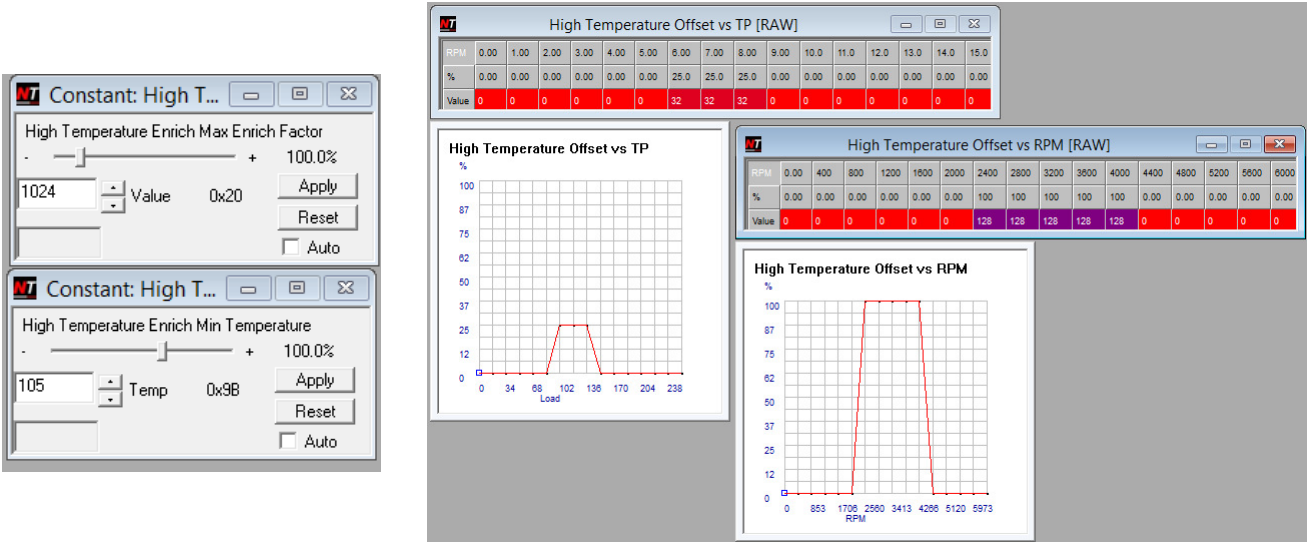


High Coolant Temp Enrichment (SR20DET etc)

Summary:

Some Nissan ECUs performs additional enrichment for engine protection at very high temperatures (105 degC). Load and RPM tables adjust this enrichment up to the maximum enrichment coefficient allowed

Note: Not all ECUs use these this additional enrichment





## Throttle Enrichment tables (RB20DET etc)

Summary:

Only available for some (early RB series) vehicles, and limited in function. If available for your vehicle, it will be shown as below:

Throttle Enrich 1

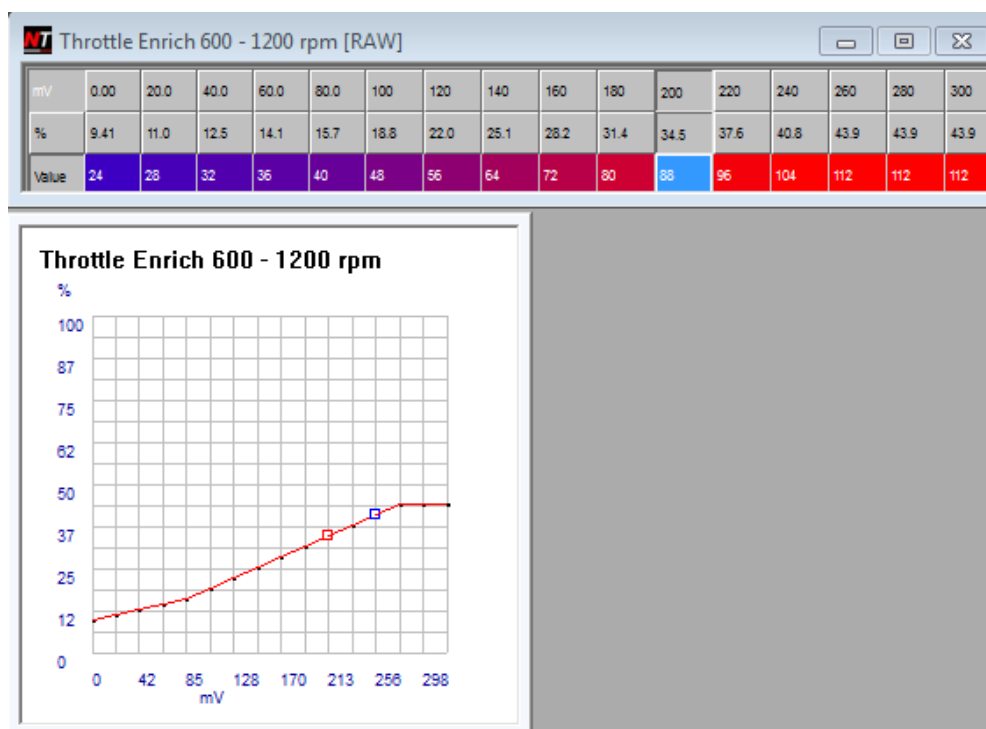
Throttle Enrich 2

Throttle Enrich 3

Throttle Enrich 4

These tables are indexed by the TPS voltage (in millivolts) and adjust the rate of TP (theoretical load) based on throttle position. The lower the number, the slower TP will move to its target. For HCR32 number are like in the table below, where with BNR32 the numbers are 255 (fastest rate) at the upper end of the table

The change is made such that lowest (1) represents slowest response, and (112) as per image below is fastest response. This table does not adjust throttle enrichment mixtures, it only controls how fast TP reaches the calculated target value



Conditions:

There are four tables in bands of:

Throttle Enrich 1: 0 rpm - 600 rpm

Throttle Enrich 2: 600 rpm - 1200 rpm

Throttle Enrich 3: 1200 rpm - 1800 rpm

Throttle Enrich 4: > 1800 rpm

Once the engine is running, if the TPS idle switch is OFF ( TPS idle will be off in consult gauges) then these tables are used.

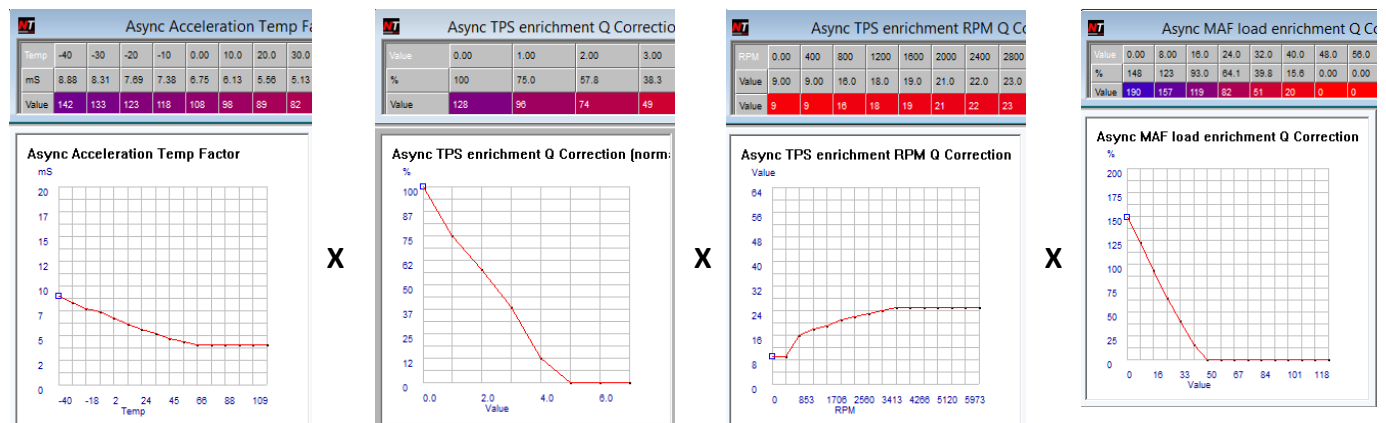
## Accelerator Enrichment (Async) (SR20DET etc)

Summary:

When throttle opened at certain rate, additional throttle enrichment is added based on the following tables

Temperature table contains the base enrichment (ms) and then adjusted by TPS rate, RPM and MAF (TP) load

Conditions: Valid from 600rpm – 3200rpm (Async min – Async max RPM)



## Wall Flow Tables (RB20DET)

Summary:

Wall flow tables affect the extra fuel spray on the walls of the cylinder during acceleration. With larger injectors, this can have an undesired effect of extra rich mixtures during transient throttle changes

Like with accelerator enrichment, the temperature factory cable contains the base enrichment (ms) and then adjusted by TPS rate, TPS position, and time and rate factors.

### [-] Wall Flow Compensation

Wall flow accel temp factor

Wall flow accel TPS delta factor

Wall flow accel TPS factor

Wall flow accel time factor

Wall flow accel rate factor

Wall flow decel temp factor

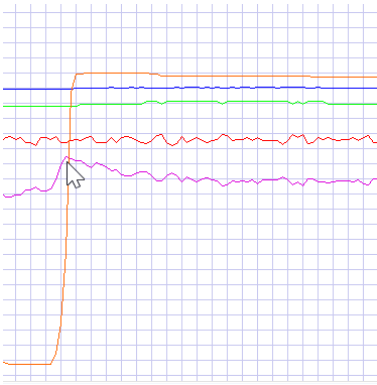
Wall flow decel TPS delta factor

Wall flow decel TPS factor

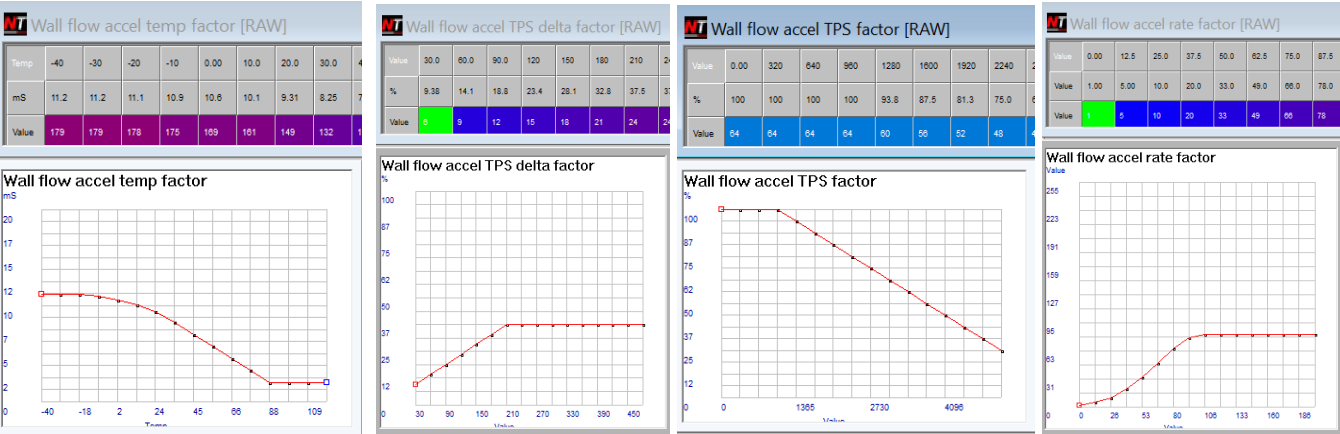
Wall flow decel rate factor

There are separate acceleration and deceleration factors depending if TPS is increasing or decreasing

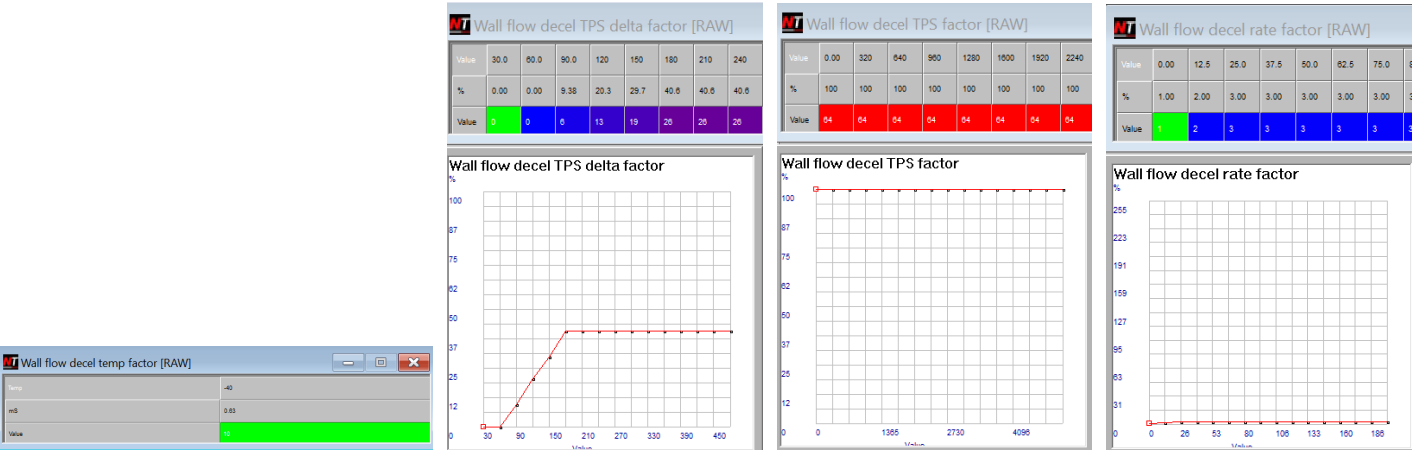
Below, we can see the TPS (orange) and the effect on injection time (purple) with the sharp wall flow increase, followed a slower decay decrease



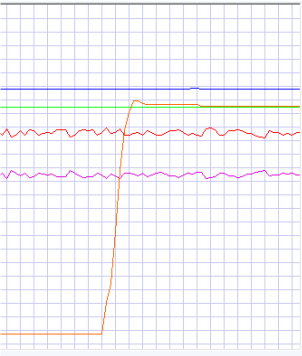
Tables for increase: (multiplied against each other, and added to injection time)



Tables for decay:



The effect of zeroing both increase and decay:

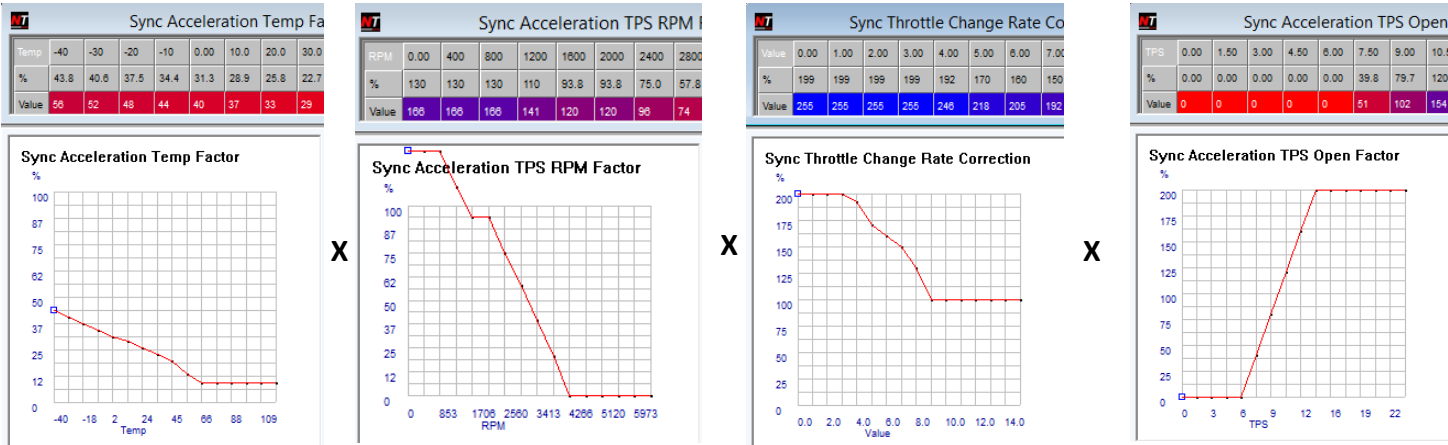


Accelerator Enrichment (Sync) (SR20DET etc)

Summary:

Used when throttle opening above certain rate to add extra enrichment.

Tables indexed by coolant temperature, RPM and TPS rate



Deceleration Reduction

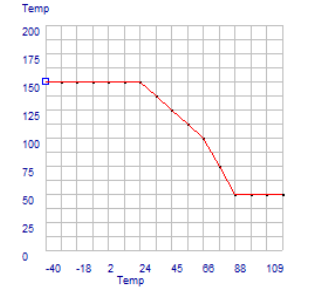
Summary:

Used during throttle closing when decelerating to reduce injection time

Tables indexed by coolant temperature, RPM and MAF voltage

Deceleration loss Temperature									
Temp	-40	-30	-20	-10	0.00	10.0	20.0	30.0	
%	150	150	150	150	150	150	150	138	
Value	192	192	192	192	192	192	192	178	

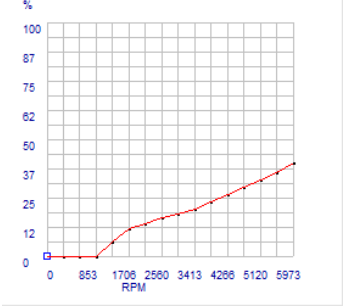
Deceleration loss Temperature correction



X

Deceleration loss RPM corr									
RPM	0.00	400	800	1200	1600	2000	2400	2800	
%	0.00	0.00	0.00	0.00	6.25	11.7	14.1	16.4	
Value	0	0	0	0	8	15	18	21	

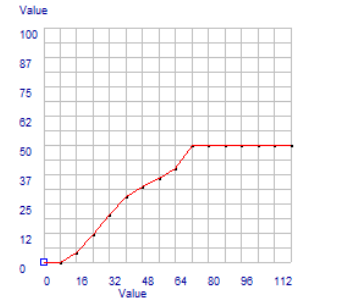
Deceleration loss RPM correction



X

Base Deceleration loss MAF C									
Value	0.00	8.00	16.0	24.0	32.0	40.0	48.0	56.0	
%	0.00	0.00	3.91	11.7	20.3	28.1	32.0	35.0	
Value	0	0	5	15	28	38	41	45	

Base Deceleration loss MAF Correction

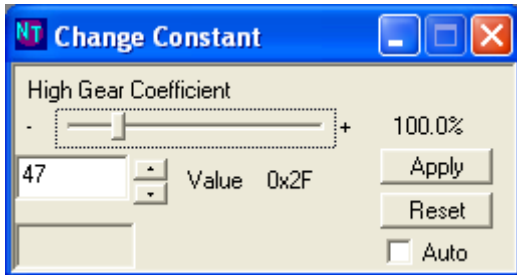


## High Gear Coefficient

Some ECU's (Z32 300ZX) have additional maps for high gear usage.

Gear Fuel Map
Gear Knock Fuel Map

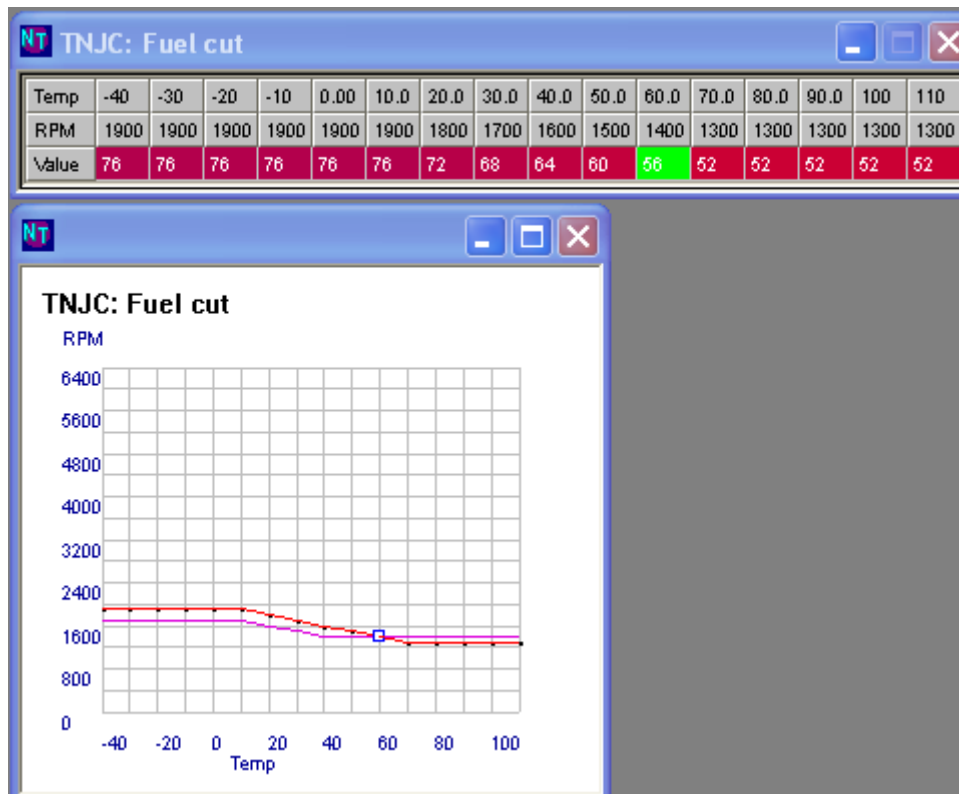
The usage of if these maps is determined by RPM, speed and the value contained in the High Gear Coefficient parameter.



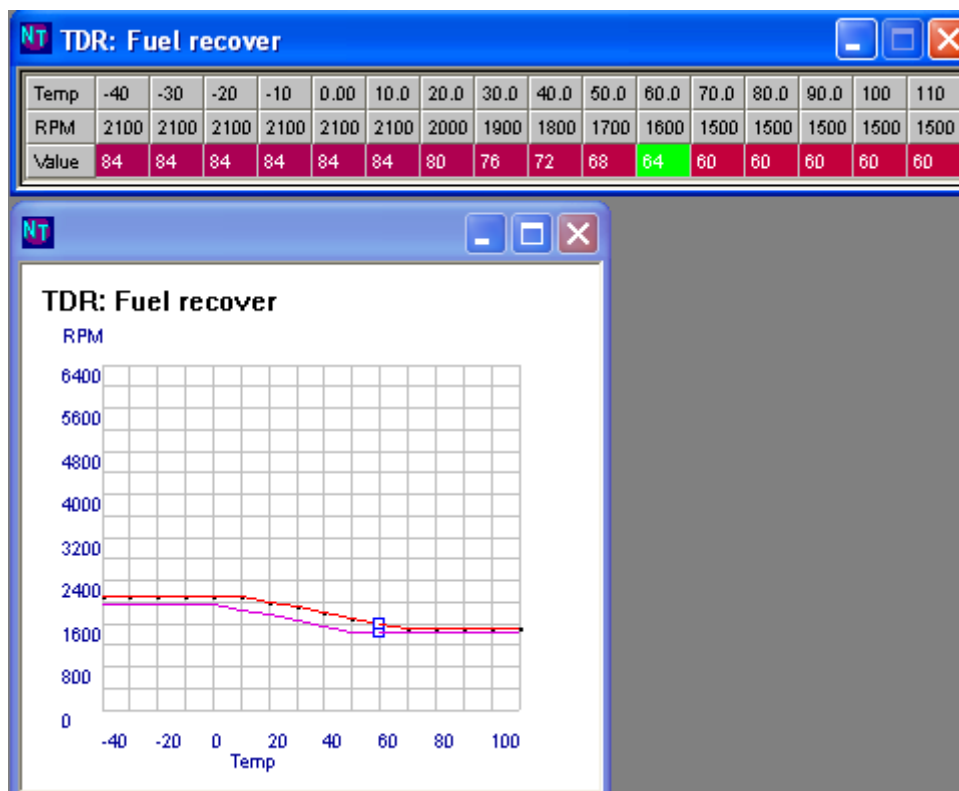
Whilst there is a specific relationship between these three parameters, it is difficult to translate and hence not displayed. It's possible to tune using the High Gear fuel maps but most tuners find it easier to disable them by setting the High Gear Coefficient to 0. This tends to produce more consistent results.

## Fuel Cut and Recovery

Nissan ECUs will cut fuel under certain conditions, for example when releasing the accelerator then fuel will be cut for a short amount of time so there is not excess fuel being injected under those conditions. Typically the fuel cut and recovery points are different for manual and automatic transmission vehicles as seen below



Here the fuel cut at normal operating temperature (85degC) will occur at 1300rpm

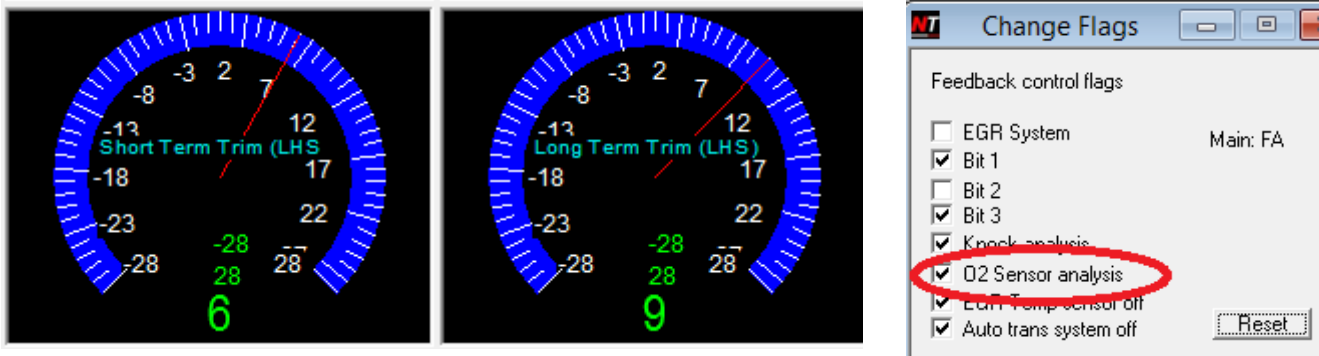


The fuel recovery will resume injection when the ECU has reached the desired RPM in this table (85degC will occur at 1500 rpm)

## • O2 Sensor Feedback

Nissan ECU's use a narrowband O2 sensor with stoichiometric AFR (air/fuel ratio) at 14.7:1 and generate a voltage of between 0 and 1V. Being a narrowband sensor the voltage swings abruptly as AFR's vary above and below 14.7:1. So although 14.7:1 is theoretically at 0.5V, in practice the voltage will either be above or below this voltage – swinging rapidly from around 0V (lean) to 1V (rich). It can be thought of as more of a switch which changes state around 14.7:1.

Whilst in closed loop mode the ECU will attempt to maintain 14.7:1 AFR by monitoring the O2 sensor voltage and trimming fuel delivery up or down as necessary. These are shown in the STFT (Short term fuel trim) and LTFT (Long term fuel trim) respectively. Short term is reset on each vehicle power on. Long term trims can be cleared using consult active test.



- Short and Long term trims are referred to as AF Alpha internally by Nissan as the factors which adjust the final injection pulsewidth
- Previous short and long term trim values are used even after O2 analysis is disabled
- When O2 analysis is enabled short term trims will be adjusted by the ECU based on the trimming compensation required to maintain stoichiometric air fuel ratios

## Closed Loop conditions

There are several conditions which must be met in order to stay in closed loop. The O2 sensor must be heated to the correct temperature, engine coolant temperature must be above a certain point (closed loop is not used at cold start) and the fuel map must be in the closed loop area. Some vehicles must also be above a certain speed before closed loop becomes active. This is indicated in Nistune by the aqua cells when the 'Flags' tick-box is enabled – see 300ZX example below.

Load	8	16	20	24	28	32	36	40	44	48	52	56	64	72	80	88
6400	13	13	13	13	18	24	30	35	41	47	47	50	51	56	56	60
6000	13	13	13	13	18	24	30	35	41	47	47	50	51	53	53	57
5600	13	13	13	13	18	24	30	35	41	47	47	47	49	49	49	56
5200	13	13	13	13	18	18	26	26	33	39	41	41	50	51	51	55
4800	186	186	186	187	187	7	12	17	22	26	30	32	36	53	54	54
4400	185	185	186	186	186	186	4	7	7	7	15	25	36	45	47	47
4000	187	187	188	188	187	186	186	5	5	10	15	22	28	35	41	41
3600	190	190	191	190	189	188	187	5	5	5	16	23	28	32	36	36
3200	185	185	187	189	189	189	188	5	5	5	14	19	22	26	29	29
2800	184	184	187	188	188	188	188	188	188	188	188	12	22	27	27	27
2300	186	186	187	187	188	188	188	188	188	188	188	7	21	21	21	21
2200	186	186	188	188	188	188	188	188	188	188	192	8	21	21	21	21
1600	188	188	189	189	189	189	188	187	186	186	5	10	15	15	15	15
1200	190	190	191	191	191	191	190	189	188	6	15	17	17	17	17	17
800	190	190	191	192	192	191	191	191	8	15	20	22	22	22	22	22
400	192	192	192	192	192	192	192	192	192	192	192	192	192	192	192	192

This is a raw view of the fuel map. All areas above 128 in this table are highlighted, and indicate that the ECU is running in closed loop in this area.



You can also view this in the target AFR view. However, note that the ECU does not know actual AFRs. This view should only be used as a guide. **The fuel map will directly adjust injection pulsewidth, not target AFRs**

Load	8	16	20	24	28	32	36	40	44	48	52	56	64	72	80	88
6400	13.34	13.34	13.34	13.34	12.89	12.38	11.91	11.54	11.13	10.75	10.75	10.57	10.51	10.23	10.23	10.01
6000	13.34	13.34	13.34	13.34	12.89	12.38	11.91	11.54	11.13	10.75	10.75	10.57	10.51	10.40	10.40	10.17
5600	13.34	13.34	13.34	13.34	12.89	12.38	11.91	11.54	11.13	10.75	10.75	10.75	10.63	10.63	10.63	10.23
5200	13.34	13.34	13.34	13.34	13.34	12.89	12.89	12.22	12.22	11.69	11.27	11.13	11.13	10.57	10.51	10.28
4800	15.42	15.42	15.42	15.30	15.30	13.94	13.44	12.98	12.54	12.22	11.91	11.76	11.47	10.40	10.34	10.34
4400	15.55	15.55	15.42	15.42	15.42	15.42	14.25	13.94	13.94	13.94	13.16	12.30	11.47	10.88	10.75	10.75
4000	15.30	15.30	15.17	15.17	15.30	15.42	15.42	14.15	14.15	13.63	13.16	12.54	12.06	11.54	11.13	11.13
3600	14.93	14.93	14.82	14.93	15.05	15.17	15.30	14.15	14.15	14.15	13.07	12.46	12.06	11.76	11.47	11.47
3200	15.55	15.55	15.30	15.05	15.05	15.05	15.17	14.15	14.15	14.15	13.25	12.80	12.54	12.22	11.98	11.98
2800	15.68	15.68	15.30	15.17	15.17	15.17	15.17	15.17	15.17	15.17	15.17	13.44	12.54	12.14	12.14	12.14
2300	15.42	15.42	15.30	15.30	15.17	15.17	15.17	15.17	15.17	15.17	15.17	13.94	12.63	12.63	12.63	12.63
2200	15.42	15.42	15.17	15.17	15.17	15.17	15.17	15.17	15.17	15.17	14.70	13.84	12.63	12.63	12.63	12.63
1600	15.17	15.17	15.05	15.05	15.05	15.05	15.17	15.30	15.42	15.42	14.15	13.63	13.16	13.16	13.16	13.16
1200	14.93	14.93	14.82	14.82	14.82	14.82	14.93	15.05	15.17	14.04	13.16	12.98	12.98	12.98	12.98	12.98
800	14.93	14.93	14.82	14.70	14.70	14.82	14.82	14.82	13.84	13.16	12.71	12.54	12.54	12.54	12.54	12.54
400	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70

### O2 Sensor Trigger Points

Given that a narrowband sensor only really has the ability to report whether it is above or below stoichiometric point, the ECU uses an upper and lower voltage limit to determine whether the ECU is running leaner or richer than 14.7:1. On some ECUs these parameters are adjustable.

NT

Change Constant

O2 sensor Lean trigger voltage

-

+

100.0%

420

mV

0x15

Apply

Reset

Auto

0.27

0.00

O2

NT

Change Constant

O2 sensor Rich trigger voltage

-

+

100.0%

1160

mV

0x3A

Apply

Reset

Auto

1.16

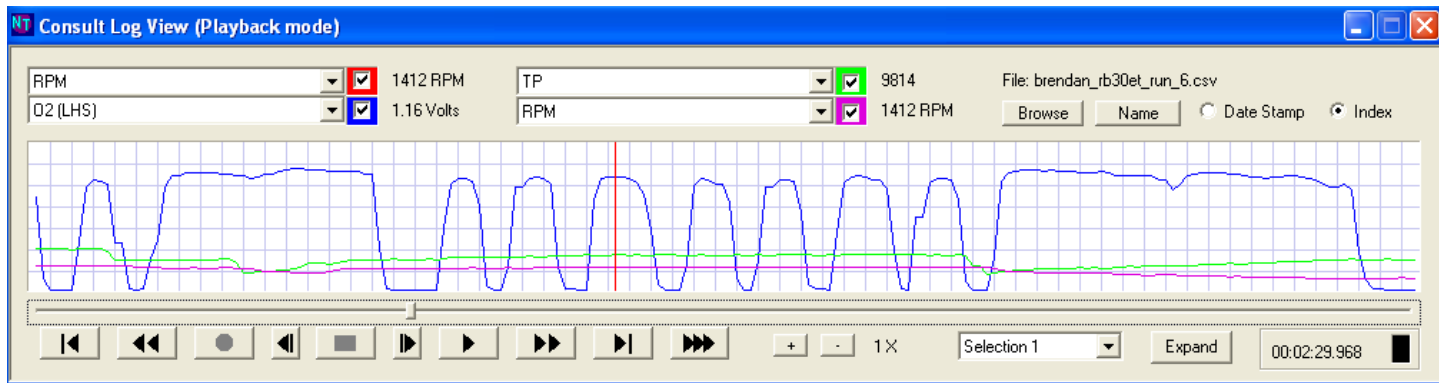
0.00

O2

### Observing O2 Sensor Activity

Activity can be observed by watching the O2 Gauge on the Gauges display. Holding the engine just above idle with no load should result in the O2 Sensor voltage switching quickly (about twice per second) between rich and lean.

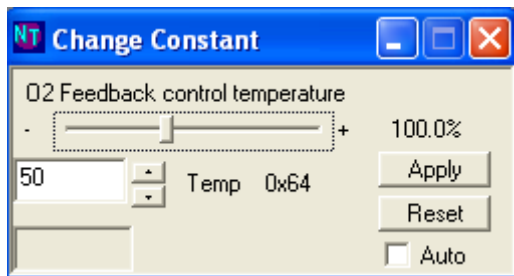
A better way is to use the log player window – (refer Section 7). You will see from the run below that the O2 (LHS) on this RB30ET bounces above/below trigger voltages as the ECU trims mixtures rich-lean-rich-lean to maintain an average 14.7:1 AFR.



## Turning Off Closed Loop

There are times when it's beneficial to have Closed Loop turned off. Mainly when trying to adjust K Constant after AFM and/or injectors have been changed. The idea being to achieve 14.7:1 in the low load areas without having the ECU try to "chase closed loop" by making corrections based on the O2 Sensor. This can be achieved in several ways.

1. Increase the temperature at which the O2 Sensor is monitored to above normal operating temperature (something like 200 degrees works well...):



2. Disable O2 sensor in the feedback control flags (where available).



3. Disable O2 Feedback for individual cells in the fuel map. Select the cell and use the 'O' key to toggle O2 Feedback. This is only possible where the AFR is richer than 14.7:1. Nissan ECUs cannot turn off O2 Feedback for leaner than 14.7:1 because the map does not have the required numeric resolution to do so.

After disabling closed loop feedback, restart the vehicle (to clear Short Term fuel trim) and use Consult Active test to clear the long term fuel trim.

Nissan ECUs have the following mapping for O2 feedback:

Raw Value	Target AFR	O2 Feedback
0 .. 127	14.7:1 ... 7.38:1	OFF
128 .. 255	29.4:1 ... 9.85:1	ON

Note that these are theoretical AFRs. In practice some vehicles follow closely to what is displayed, while others do not. Obviously many factors can throw actual AFR's out – including K Constant, Injector latency, fuel pressure, etc.

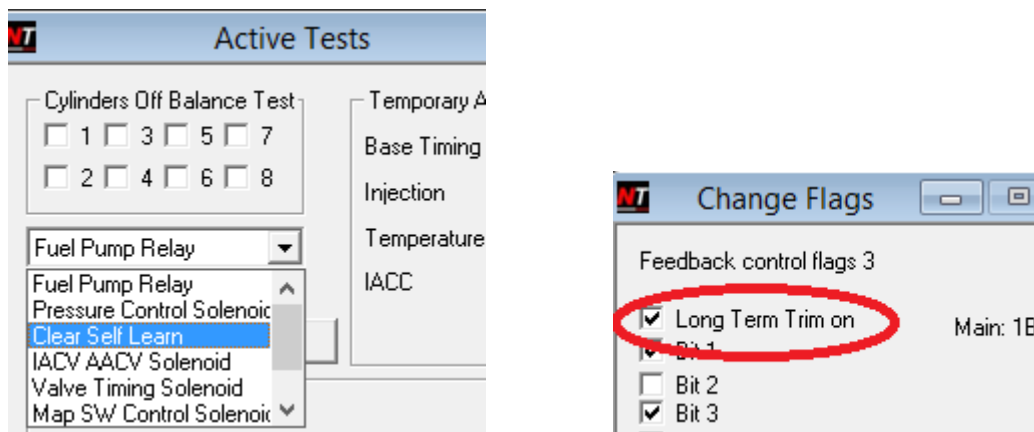
Later model Nissan ECUs will use a MAF with only 128 .. 255 values. There are no O2 trim flags in these fuel maps and O2 sensing trimming adjusted over all values containing '128' value in the map.

## AF Alpha Trimming

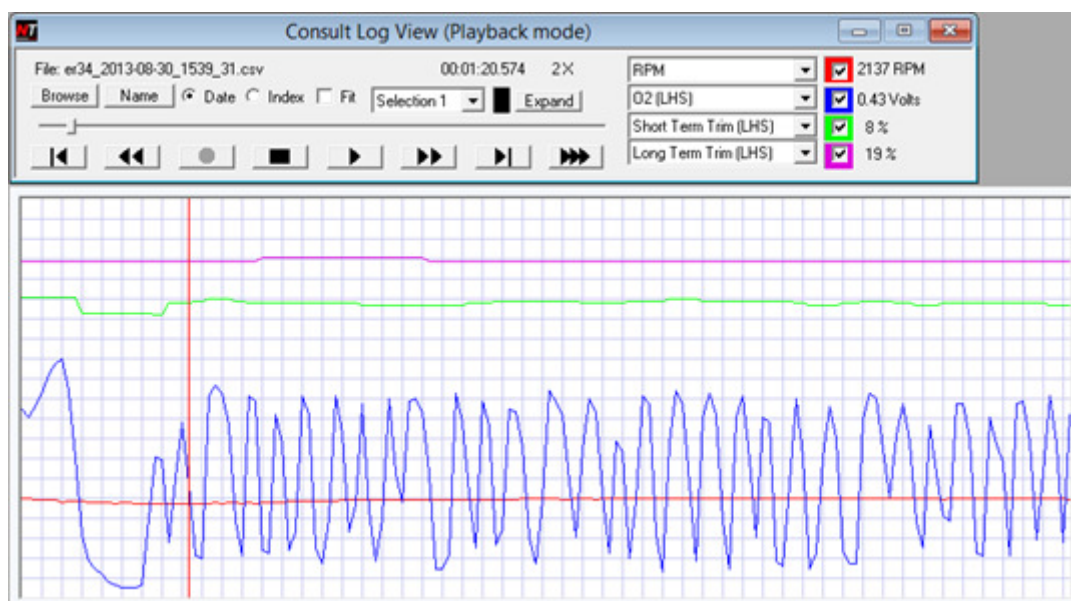
Long term trims are stored using battery backup power to the ECU

Disabling short term trims will not disable previously adjusted longer term trims. Use the Active Tests 'Clear self learn' to reset trimming to 0%

AF Alpha short and long term trimming factors will be used regardless if the ECU currently is in closed loop parts of the map or not. Some ECUs can disable this



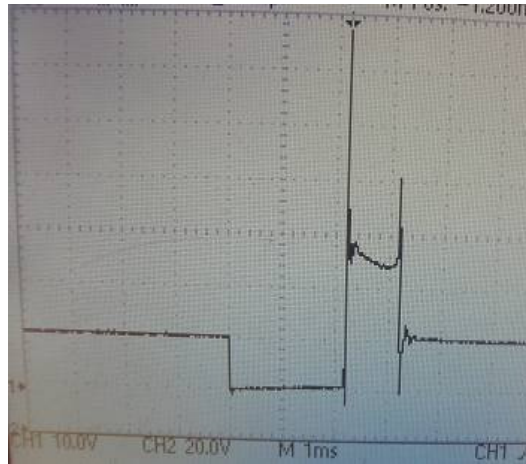
Use the log viewer to monitor O2 sensor oscillation and short and long term trim adjustments. Aim for 0% long and short term trims



## 2. Ignition Timing

**Overview:** Ignition timing is the point at which the spark plug ignites the fuel in the cylinder relative to the piston being at Top Dead Centre (TDC) on the firing stroke. It is expressed as degrees before TDC.

The ECU uses the Crank Angle Sensor (CAS) to determine the crank position. It then uses coil dwell and duty tables to determine coil charge time for current battery voltage and RPM. These tables are available for most ECUs supported by Nistune.



*Picture above: Output to primary coil from power transistor (triggered from ECU). Secondary coil output is what causes the massive spike and creates the spark*

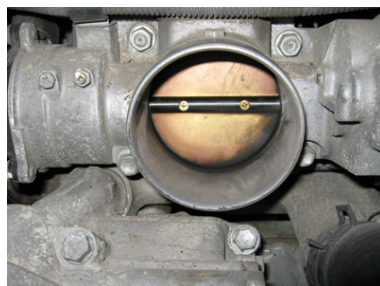
Different timing maps/tables are used across various Nissan ECUs. Some of the tables covered may not be used in your particular ECU. Earlier ECU's tend to have less maps/tables available.

The main factors affecting timing map/table access are: - Coolant Temperature, Knock Sensor, Throttle Position, Neutral switch, Start switch

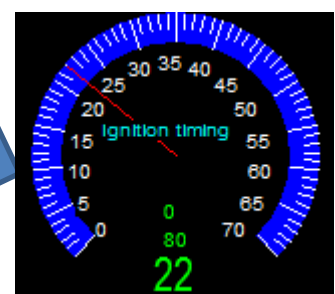
Crank Timing



Throttle Closed  
(TPS Idle) Timing



Throttle Open  
Timing



- **Main Timing Maps**

Main timing maps are used to determine IGN timing based on engine load (TP) and RPM under normal operating conditions. This area typically requires considerable attention if IGN timing is to be optimised for all combinations of load and RPM.

*Note: The “base” IGN timing must be set correctly using a timing light before any meaningful tuning can take place. Simply read the IGN timing reported by the ECU in Nistune and ensure that the reading taken with the timing light matches this value. The ECU has no absolute timing reference – it relies on the CAS being correctly set to match what it expects. If this is out then all timing figures reported by the ECU are out by the same amount.*

As with the fuel maps, there may be multiple timing maps. Most ECU's use a Primary and a Knock map. Some also use a separate map for top gear operation.

A common problem is when the ECU jumps to the knock maps during tuning. This can be due to knock sensor problems or knock sensor detecting noise from a worn engine. Running extra boost can also exacerbate this issue. To check if this is happening check that the timing value reported matches what the IGN map is commanding.

Load	8	16	24	32	36	40	44	48	52	56	64	72	80	88	96
6400	43	43	43	43	40	38	36	33	29	28	26	25	21	19	19
6000	43	43	43	43	40	38	36	33	29	28	26	25	23	20	20
5600	43	43	43	43	40	38	36	33	29	28	27	26	25	22	22
5200	43	43	43	43	40	38	35	33	29	28	27	26	25	22	22
4800	35	37	41	43	40	37	34	33	30	29	28	27	26	23	21
4400	35	37	41	43	40	38	36	33	30	29	27	27	25	24	24
4000	35	37	41	43	40	37	36	33	31	31	29	28	25	23	23
3600	35	37	41	42	40	35	34	33	31	30	29	28	26	23	21
3200	35	44	44	44	39	35	33	32	31	29	158	154	149	148	148
2800	35	45	45	41	39	35	33	32	32	160	158	151	147	147	147
2400	35	45	45	40	38	36	34	31	29	28	160	154	148	148	148
2000	35	40	44	42	40	37	34	28	22	153	153	148	143	143	143
1600	28	40	38	38	37	34	29	22	22	152	147	145	145	145	145
1200	15	38	30	30	30	28	22	19	144	142	142	142	142	142	142
800	15	40	32	28	25	21	12	8	135	132	130	130	130	130	130
400	15	25	20	15	5	5	5	5	5	5	5	5	5	5	5

Note: Values displayed with lighter blue shading represent knock monitoring areas in the timing map. These have 128 added to the actual timing value Viewing in **filtered mode** will normalise the ECU data display

Where the timing value on the map is around 39 degrees (surrounding cells are 41, 39, 40, 38) then the interpolated value on the gauges should be around 39.

If values around this area are adjusted, the reported timing should reflect the changes:

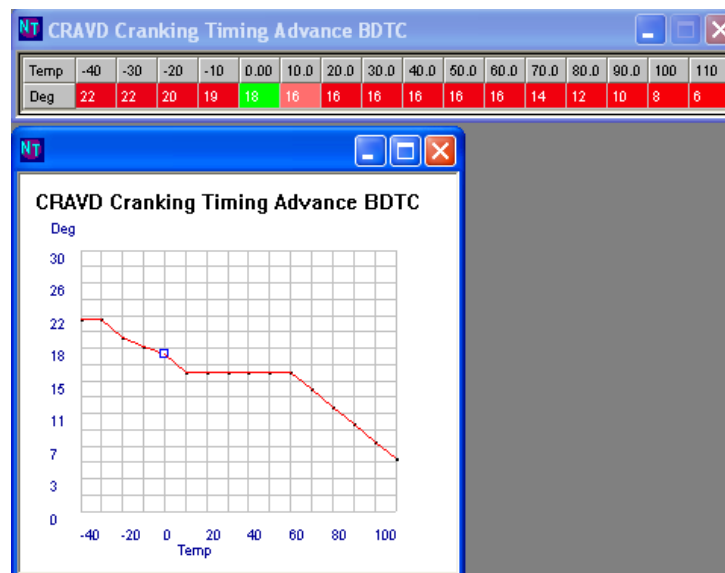
37	41	43	40	37	36	3
37	41	42	40	35	34	3
44	55	55	50	46	33	3
45	56	52	50	46	33	3
45	56	51	49	47	34	3
40	55	53	51	48	34	2
40	38	38	37	34	29	2
38	30	30	30	28	22	1

Batt	0.0	CO
TP	7527	CO
TPS	0.44	
Timing	50	
AAC	0	
FTemp	-50	

- **Cranking Timing Table**

**Description:** The amount of timing to use when the engine is cranking based on the current coolant temperature.

**Conditions:** The cranking timing table sets the timing value whilst engine is cranking. The ECU will monitor the Start sw start indicator and use this table accordingly. Other timing tables are not used when this table is being accessed. Once the engine has been started and RPMs are registered, then this table will no longer be accessed.

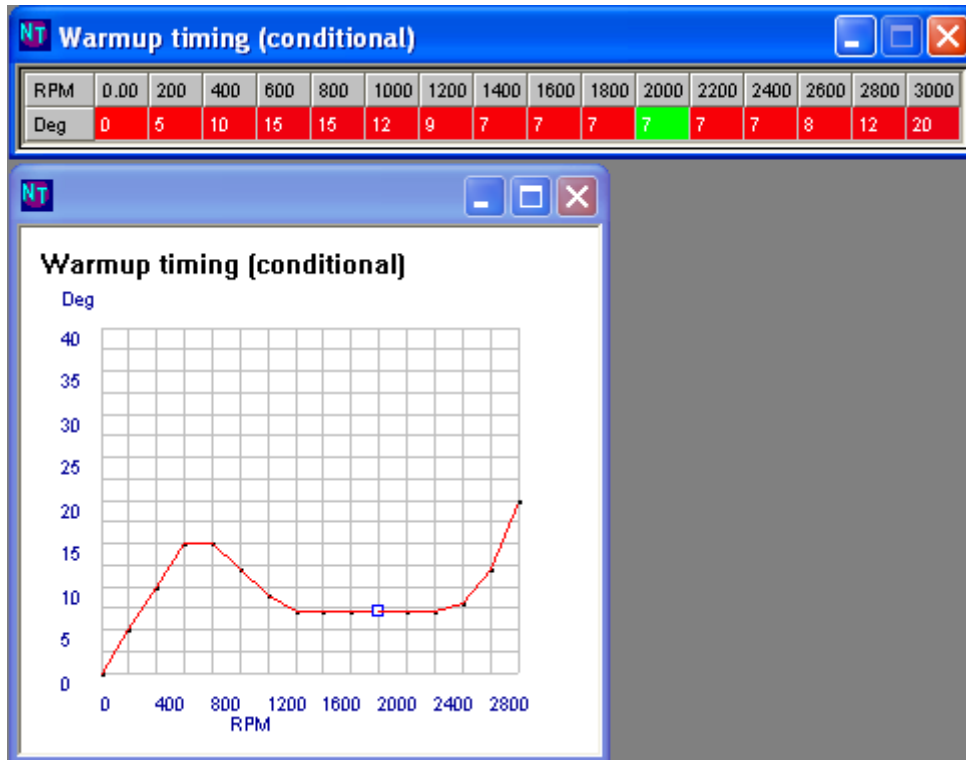




- **Warmup Timing Table**

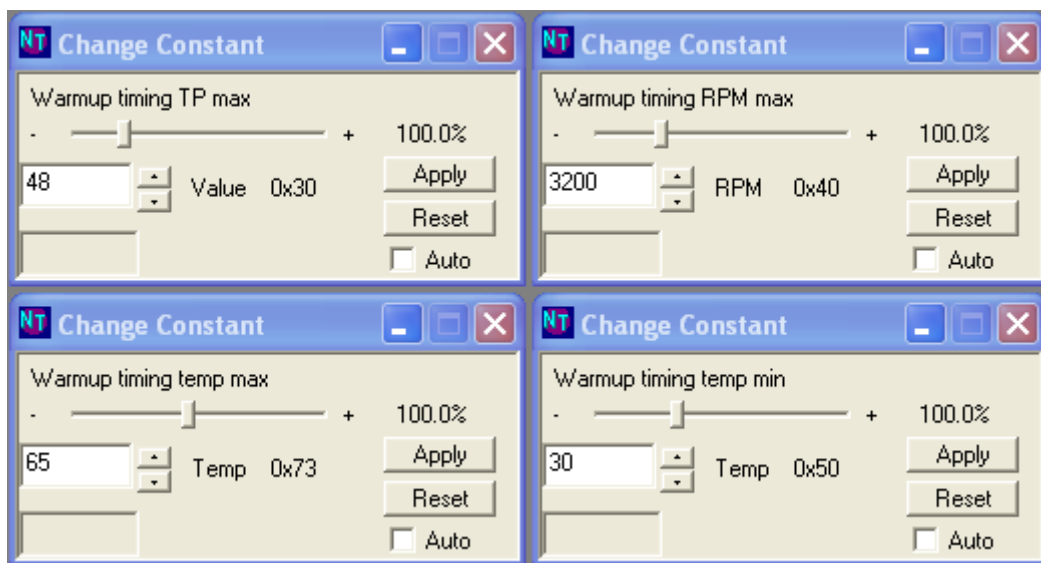
**Description:** This table is used to determine timing to be used based on the current RPM. It is a more specific conditional table which means that its accessed then certain conditions are met.

**Condition:** In this case the Coolant Temperature, RPM and TP values are monitored by the ECU prior to using this table. It has been noted that when logs of timing is pulled that sometimes this map can be the culprit



The below conditions are the temperature range in which this table is used. The temperature range is between 30 degrees C and 65 degrees C.

The table is used when the TP is below 48 and RPM is below 3200 rpm.



Given the RPM and TP window from the above constants. This indicates that quite a substantial part of the timing table uses this window as can be seen below in blue:

Load	12	16	20	24	28	32	36	40	48	52
6400	29	29	29	28	28	28	27	26	24	22
6000	29	29	29	28	28	28	27	26	24	22
5600	29	29	29	28	28	28	27	26	24	22
5200	29	29	29	28	28	28	28	27	26	25
4800	29	29	29	28	28	28	28	27	27	27
4400	36	36	36	35	35	33	31	30	28	28
4000	43	43	41	39	36	35	33	32	29	29
3600	43	43	42	40	38	36	33	31	30	29
3200	41	41	40	38	36	34	32	31	29	28
2800	41	41	39	37	35	33	32	31	27	26
2400	40	40	38	36	34	32	30	28	26	25
2000	38	38	37	35	33	31	29	27	24	22
1600	34	34	33	32	29	27	25	23	22	21
1200	32	32	31	29	27	25	23	22	18	17
800	28	28	25	22	19	17	16	15	13	12
400	5	5	5	5	5	5	4	3	1	0

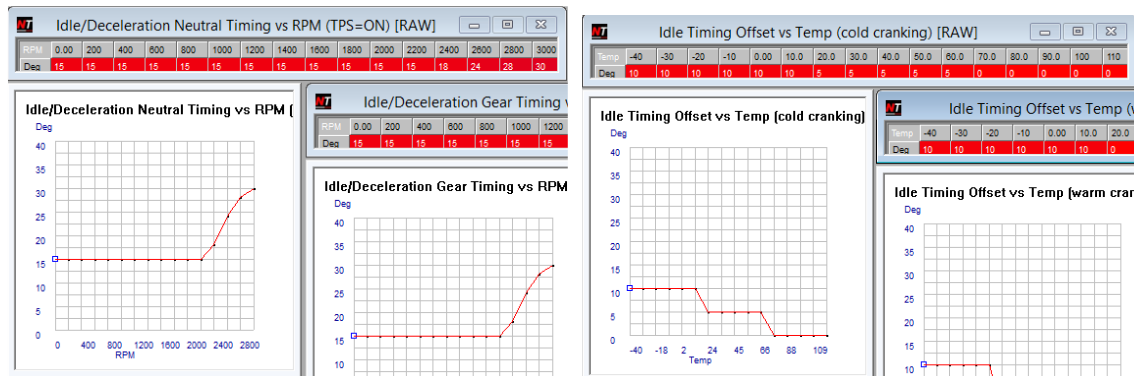
When K constant gets adjusted, sometimes the TP increases to compensate for more airflow. To avoid 'bogging' down when the engine is still warming up due to the changes in TP rescaling, the 'Warmup timing TP max' may need to be adjusted.



- **Idle Timing Changes**

Description:

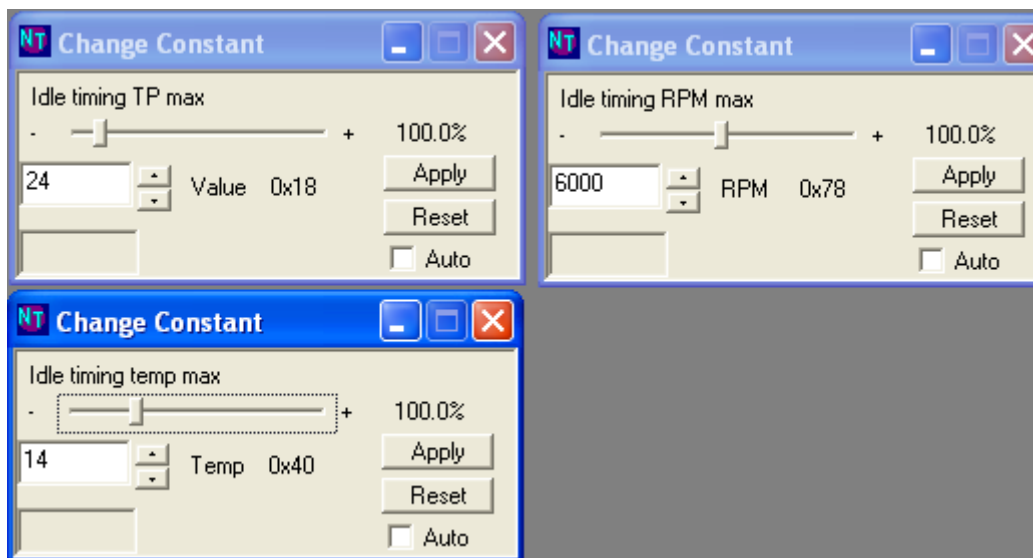
When idle timing comes into effect timing will get pulled back from what is on the main timing maps to what is in the individual tables. This is dependent on engine temperature



Conditions:

Typically say for the Z32 300ZX the tables are used upto 60 degreesC. It is possible to configure this limit in the future to determine when the tables are used.

Below are the constants available for HCR32 to determine when the idle timing tables are used.



For the Z32 300ZX. There are basically four different tables and determines if you are in gear and if the Air Conditioning is on/off

### Cold Idle Neutral Timing AC OFF

### Cold Idle Neutral Timing AC ON

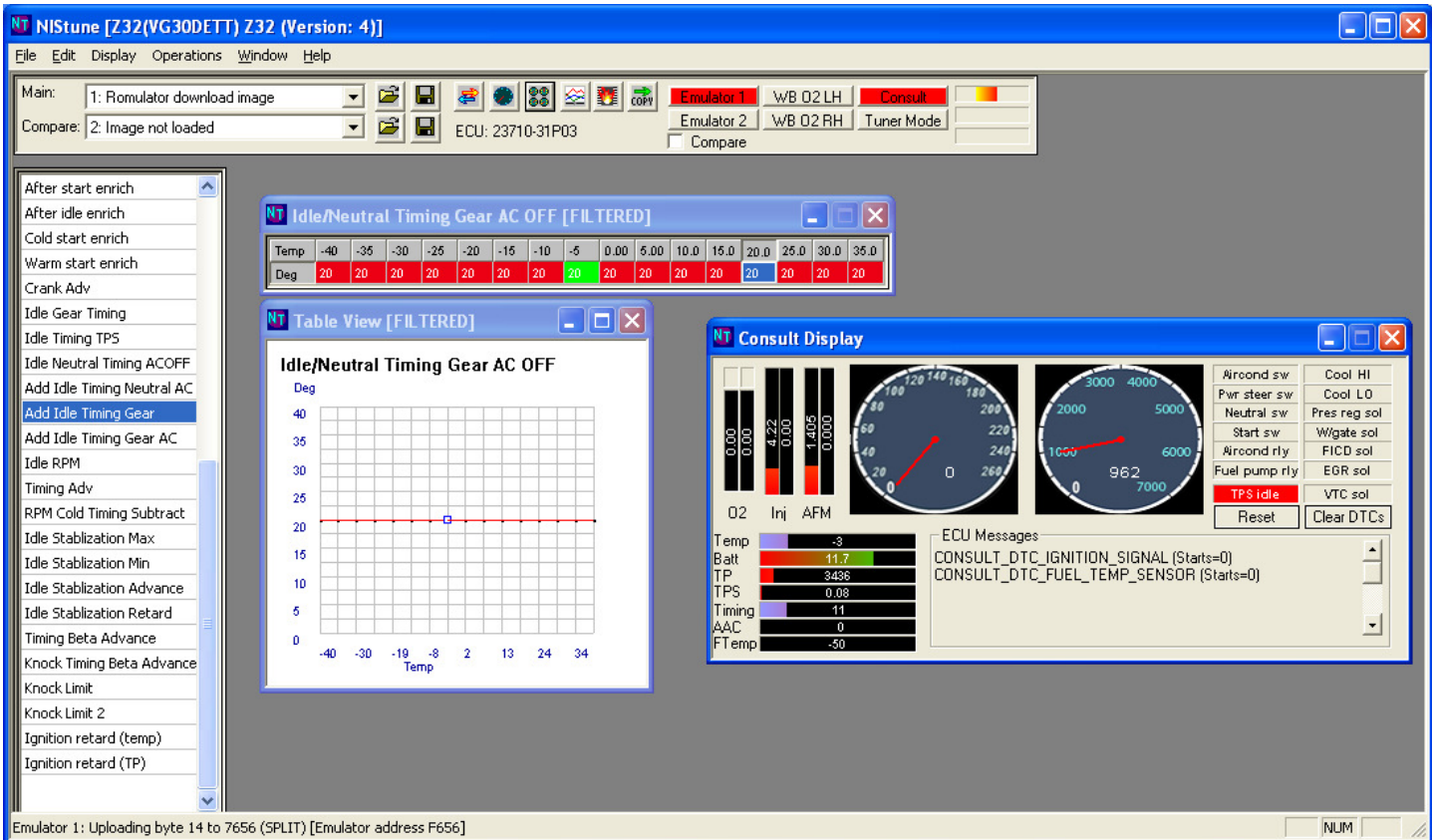
### Cold Idle Gear Timing AC OFF

### Cold Idle Gear Timing AC ON

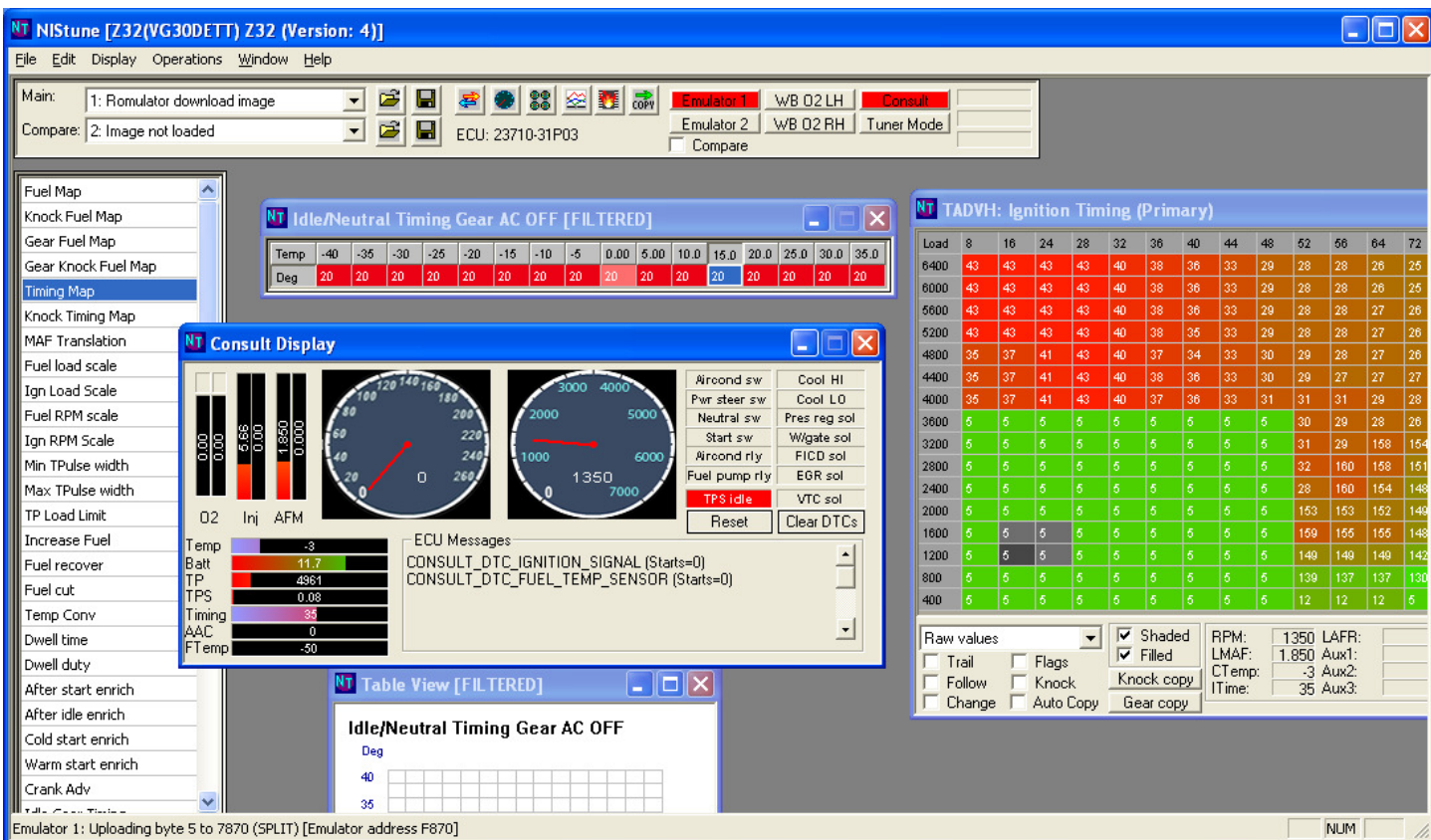
Looking at the example below, you see that TPS is 'TPS Idle' and that the cable is based on engine temperature.

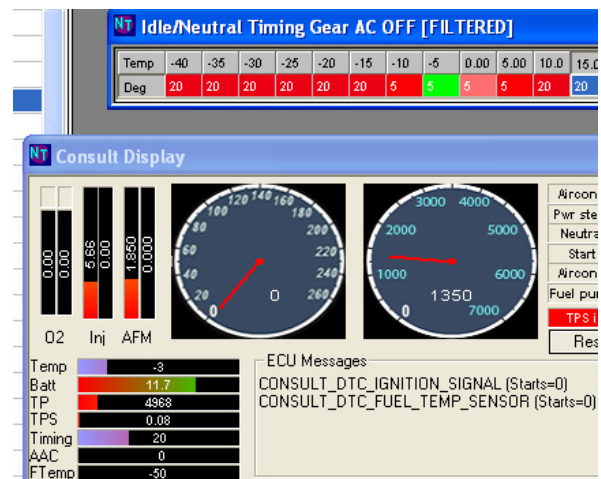
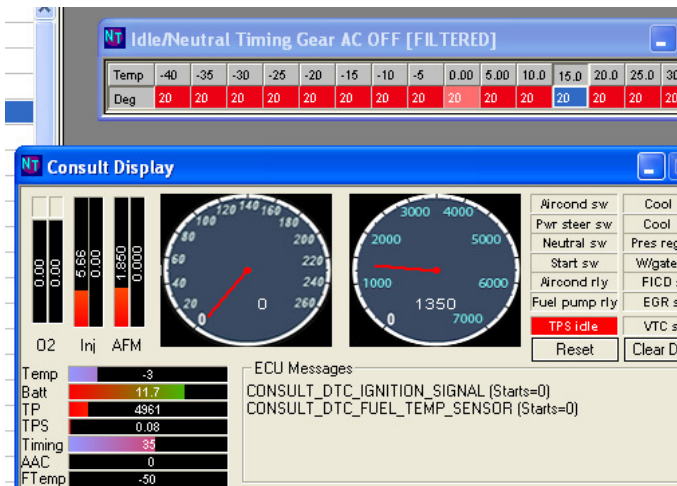
Based on the particular engine temperature, the degrees of timing in the selected table are added to a 'base timing' calculated by the ECU.

Adjusting this table will adjust the base timing. It may use this timing in addition to timing from the ignition timing maps, depending on load and RPM. The ECU makes decisions what load and RPM before deciding if to use this table

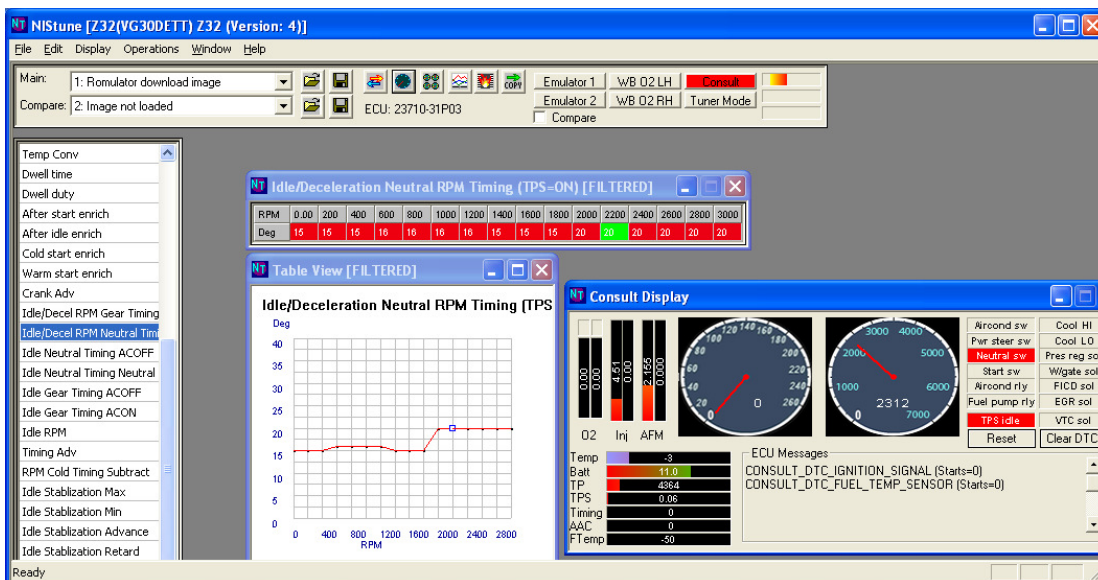


In the example below, altering the timing from 20 to 5 changes the timing from 35BDTC to 20BDTC





The timing is used as a combination of the various timing maps in the ECU and is pulled in depending on the temperature, TPS switch, neutral switch, TP and RPM conditions met in the ECU



Idle / Deceleration RPM appear to be trigger points where for a particular RPM reached, if the timing is below the value in the chart then timing is cut to 0 until it recovers. Used to cut timing during deceleration.

Other ECUs such as HCR32 use different tables. They are not temperature dependent but TPS and gear position dependent

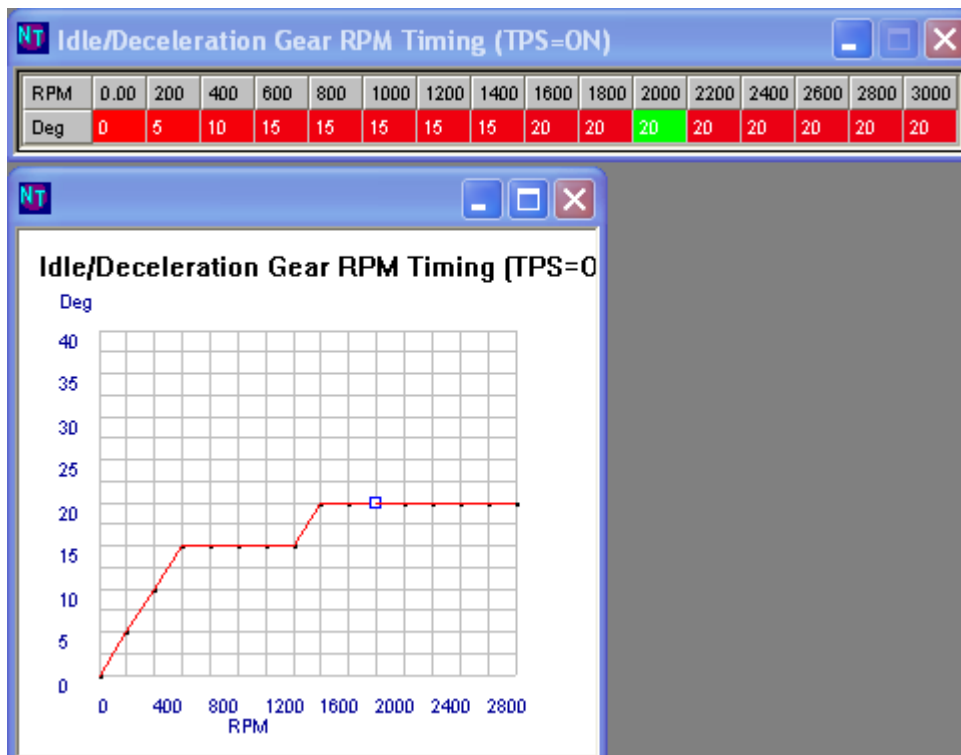
## • Idle/Deceleration Gear RPM timing

Description:

This is the timing used based on current RPM. It is used during idle and deceleration when in gear

Conditions:

This table currently being accessed is in gear (neutral is off) **Neutral sw** and TPS is on **TPS idle**. The main timing map is not accessed and the consult timing is based from this map.



- **Idle/Deceleration Neutral Timing**

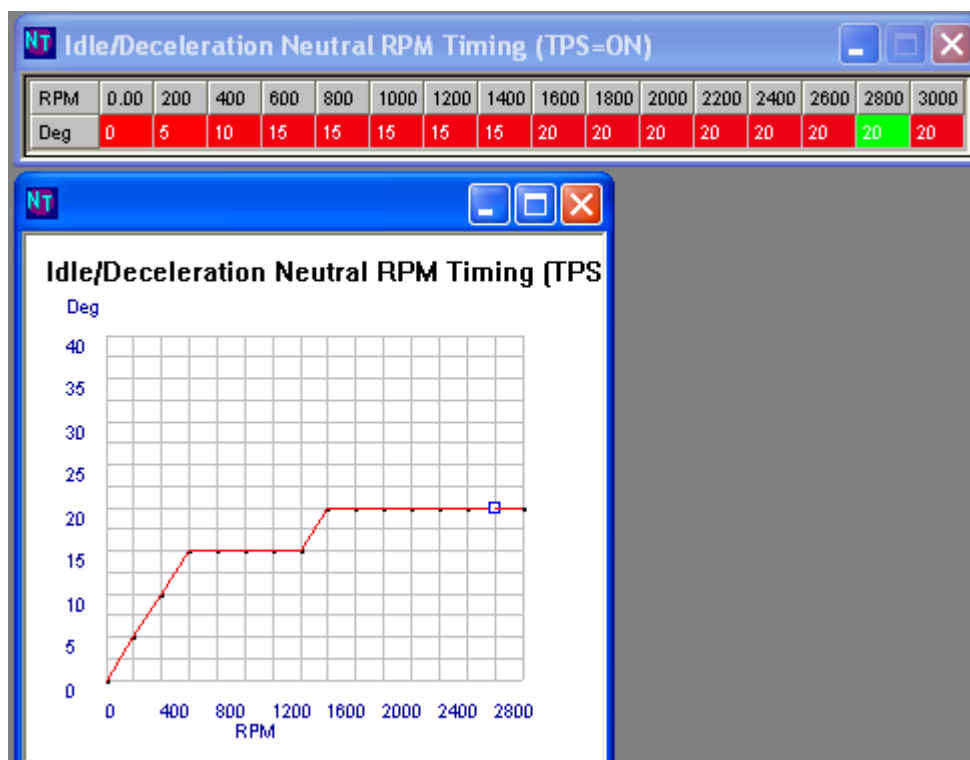
Description:

This is the timing used based on current RPM. It is used during idle and deceleration when in neutral

Conditions:

This table currently being accessed is in gear (neutral is off) **Neutral sw** and TPS is on **TPS idle**. The main timing map is not accessed and the consult timing is based from this map.

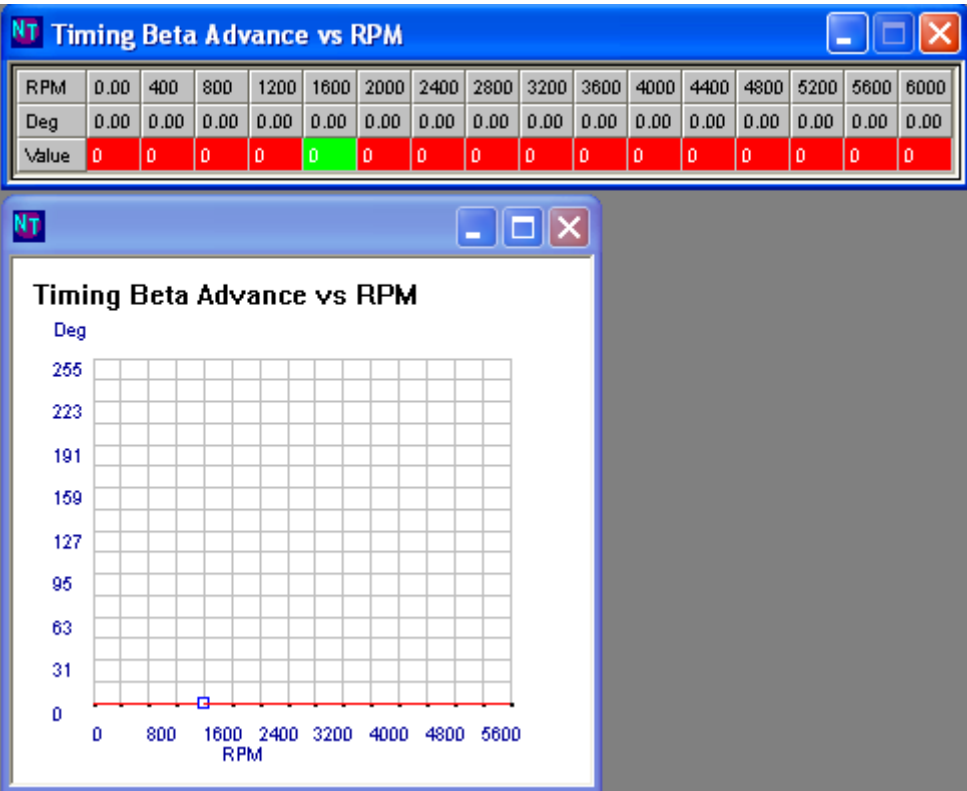
*Note: From observations with Z32 so far it appears even with Neutral switch on the Idle/Deceleration Gear timing table is being used rather than this one*



• **Timing Beta Advance**

Description:  
Table advances timing further based on RPMs.

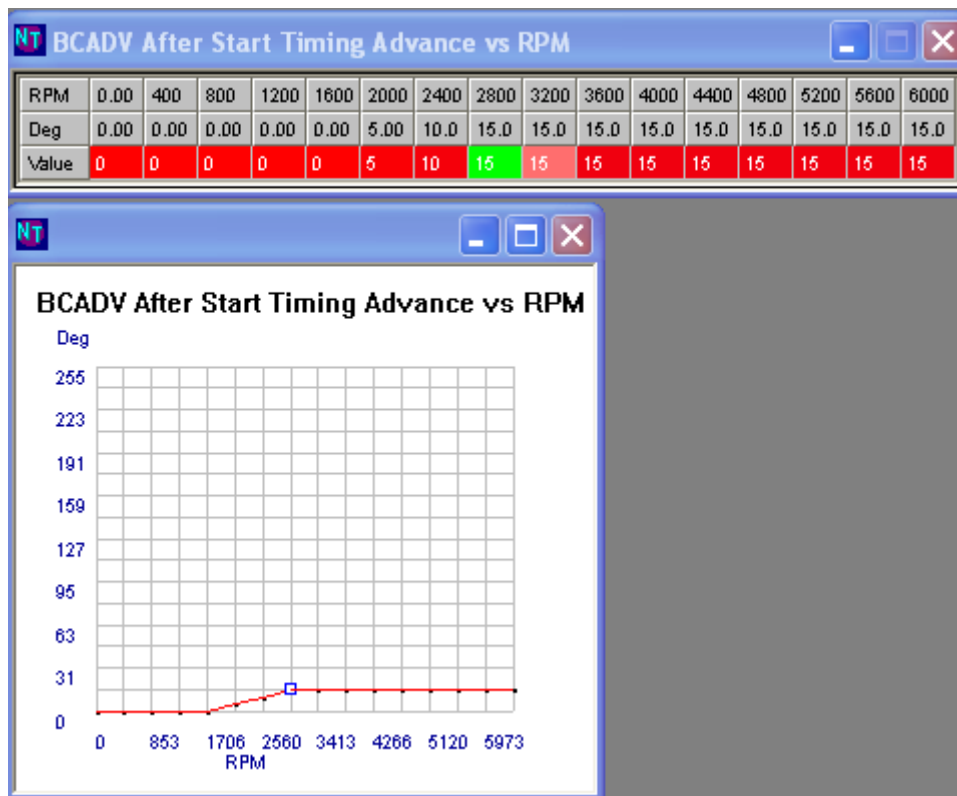
Conditions:  
Notably on HCR32 below this is zeros and hardware map tracing indicates that this table is not regularly accessed during normal conditions.



• **After Start Timing Advance**

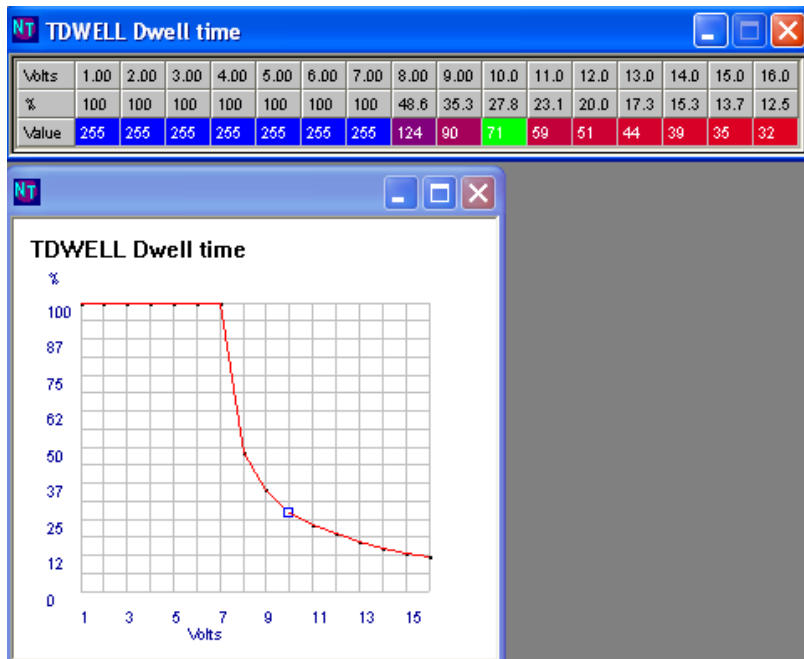
Description:  
This table is used for timing advance after starting the engine.

Conditions:  
It is only accessed when TPS TPS idle is not idle. However if the main map is being accessed instead then this table is notably not used.



- **Dwell Time table**

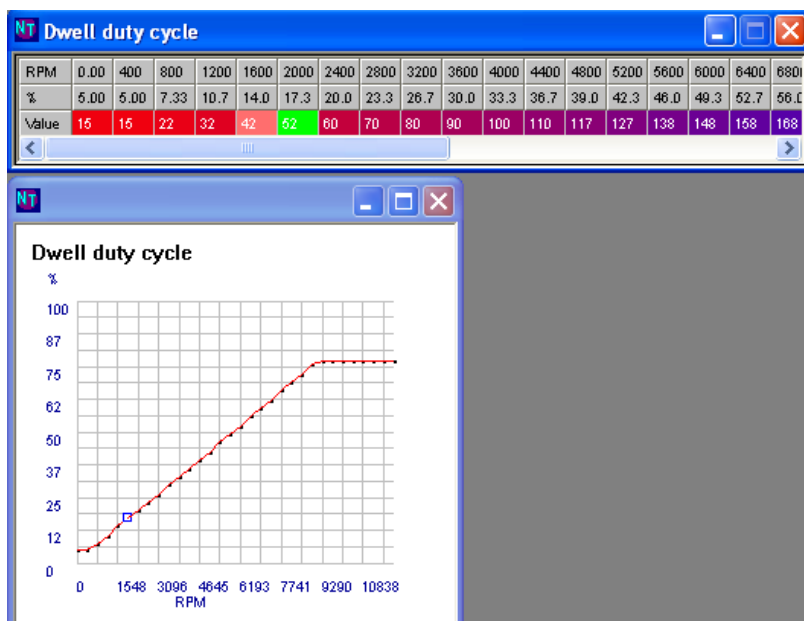
Description: Dwell time is the coil charge time against battery voltage. You will notice as the voltage becomes lower the dwell time is increased.



When adjusting for larger coils, adjust this table. Default Nissan coil charge time is approximately 3ms. Doubling the values in this table would increase this for example to 6ms (used with LS-2 coils say)

- **Dwell Duty Cycle**

Description: Dwell duty cycle is the percentage of time to charge the coil against RPM. This table should not be adjusted. It is used to compensate for the reduced coil charge time in the ECU hardware as RPMS increase. This table calibrates an approximate default 3ms throughout the rev range.



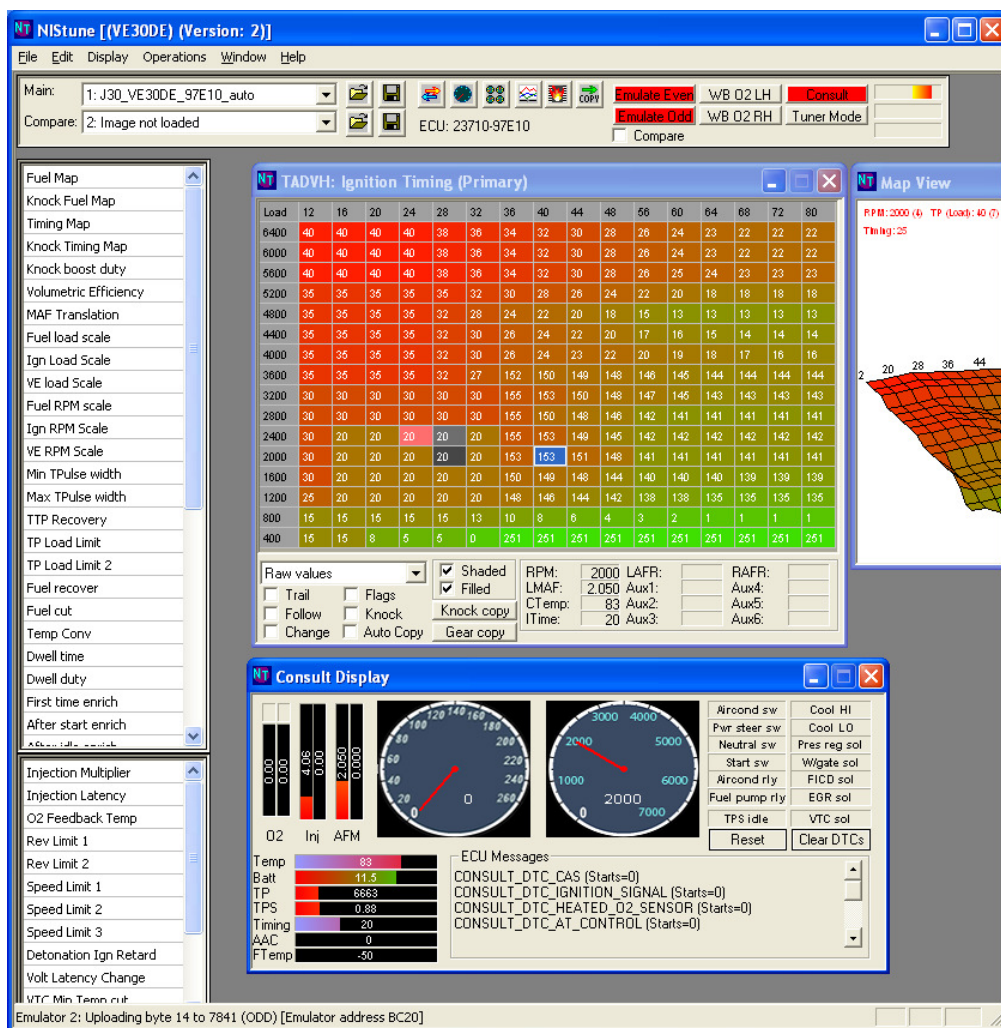
*Note: Some ECUs will display an estimated coil charge time in the Nistune gauges in the software. Not all ECUs have this feature enabled*



- **Example: Determining if timing map used (J30 VE30DE)**

Check timing works at 80 degrees Celcius or over when TPS is not idle

TPS idle



Filled area with 20 degrees and then adjust and monitor timing

Now adjust TPS so that 'TPS idle' is lit

Notes: Timing map hardware trace (pink) indicates Timing map no longer used. Timing gauge indication reads 28 degrees BDTC

- **Other Confusing Timing Problems**

For some reason unknown to us, Nissan uses different Timing offsets in their maps for some of their vehicles. The assumption is that different engineering teams who wrote and mapped the ECUs used offsets on some product lines.

A classic example is with the S13 KA24E ECU (240SX USDM). This particular ECU has caught our attention because some of the problems tuners have experienced with it.

This requires address files modified from standard and some understanding of what is going on.

Here is a standard 'raw' timing map from the 23710-42F65 S13 KA24E ECU:



**TADVH: Ignition Timing (Primary)**

Load	3	6	9	12	15	18	21	23	25	27	29	31	33	35	36	37
6000	60	60	60	59	58	52	46	41	41	41	41	41	41	41	41	41
5600	60	60	60	58	55	51	45	39	38	37	37	37	37	37	37	37
5200	58	58	58	56	52	49	46	42	38	34	33	33	33	33	33	33
4800	53	53	53	49	46	43	41	38	36	33	31	31	31	31	31	31
4400	51	51	51	47	44	41	39	37	35	32	28	28	28	28	28	28
4000	51	51	51	48	45	42	39	35	32	29	27	27	27	27	27	27
3600	52	52	52	49	46	43	40	37	35	33	31	29	29	29	29	29
3200	50	55	55	54	51	47	42	38	35	31	28	26	26	26	26	26
2800	52	57	57	57	54	49	43	38	33	29	26	24	24	24	24	24
2400	52	57	57	56	50	46	43	38	32	29	26	24	23	23	23	23
2000	52	57	57	57	48	42	39	36	30	27	22	20	20	20	20	20
1600	47	50	49	47	44	39	34	30	25	23	19	18	18	18	18	18
1400	38	38	44	43	42	35	28	28	23	21	19	17	16	16	16	16
1200	38	38	38	39	39	34	28	25	20	18	16	15	14	13	13	13
800	30	30	33	38	38	32	24	20	17	14	12	11	11	11	11	11
600	30	30	33	38	38	32	24	20	17	14	12	11	11	11	11	11

Raw values Shaded RPM: 1187 LAFR: RAFR:

Something doesn't look right here. The timing at idle is incredibly high. Most Nissan engines are at 15 degrees BDC at 800rpm on low load at 85 degC coolant temperature. This one is at 30 degrees

So we add the following to our address file to rectify this and the offset can be viewed by looking at the 'Filtered values' selection instead. This reduces the values in the raw map to map real life values measured with a timing light on the crank timing indicator.

TIMING\_MAP\_OFFSET=15

**TADVH: Ignition Timing (Primary)**

Load	3	6	9	12	15	18	21	23	25	27	29	31	33	35	36	37
6000	45	45	45	44	41	37	31	26	26	26	26	26	26	26	26	26
5600	45	45	45	43	40	36	30	24	23	22	22	22	22	22	22	22
5200	43	43	43	41	37	34	31	27	23	19	18	18	18	18	18	18
4800	38	38	38	34	31	28	26	23	21	18	16	16	16	16	16	16
4400	36	36	36	32	29	26	24	22	20	17	13	13	13	13	13	13
4000	36	36	36	33	30	27	24	20	17	14	12	12	12	12	12	12
3600	37	37	37	34	31	28	25	22	20	18	16	14	14	14	14	14
3200	35	40	40	39	36	32	27	23	20	16	13	11	11	11	11	11
2800	37	42	42	42	39	34	28	23	18	14	11	9	9	9	9	9
2400	37	42	42	41	35	31	28	23	17	14	11	9	8	8	8	8
2000	37	42	42	42	33	27	24	21	15	12	7	5	5	5	5	5
1600	32	35	34	32	29	24	19	15	10	8	4	3	3	3	3	3
1400	23	23	29	28	27	20	13	13	8	6	4	2	1	1	1	1
1200	23	23	23	24	24	19	13	10	5	3	1	0	-1	-2	-2	-2
800	15	15	18	23	23	17	9	5	2	-1	-3	-4	-4	-4	-4	-4
600	15	15	18	23	23	17	9	5	2	-1	-3	-4	-4	-4	-4	-4

Filtered values Shaded RPM: 1200 LAFR: RAFR:

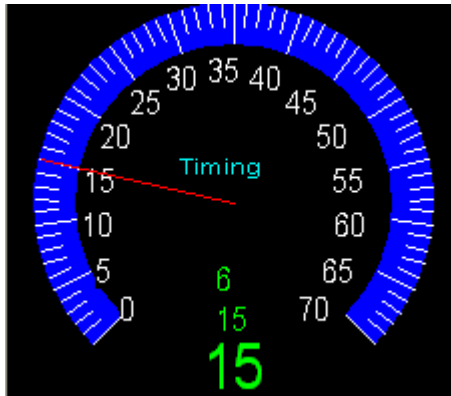
So that's all good now but the second problem is that the consult timing reported on the gauges is also incredibly off which doesn't help the tuner much either. We found this was the case with some other ECUs too so had to add an offset for consult reported timing to the address file also

CONSULT\_TIMING\_OFFSET=45

To check you have the expected timing you can then perform a test in the cells being traced

27	24	21	15	12	7
24	15	15	15	15	4
20	15	15	15	15	4
19	15	15	15	15	1
17	15	15	15	15	-3
17	9	5	2	-1	-3

Here we set the cells traced around to 15 degrees BDTC in filtered view (note: this would be 30 in raw view)



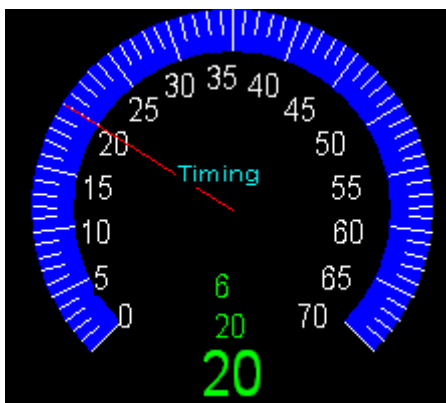
Timing is now reported accordingly, when:

- (a) Temperature is warm (above 65 degrees C typically, we test at 85 degrees for this map)
- (b) TPS idle is OFF
- (c) Neutral switch is OFF
- (d) Air conditioning switch is OFF

Okay for the next check your timing is working as expected, change the values of the highlighted cells

7	24	21	15	12	7
4	20	20	20	20	4
0	20	20	20	20	4
9	20	20	20	20	1
7	20	20	20	20	-3
7	9	5	2	-1	-3

Next your gauge should respond accordingly with the updated timing of 20 degrees BDTC

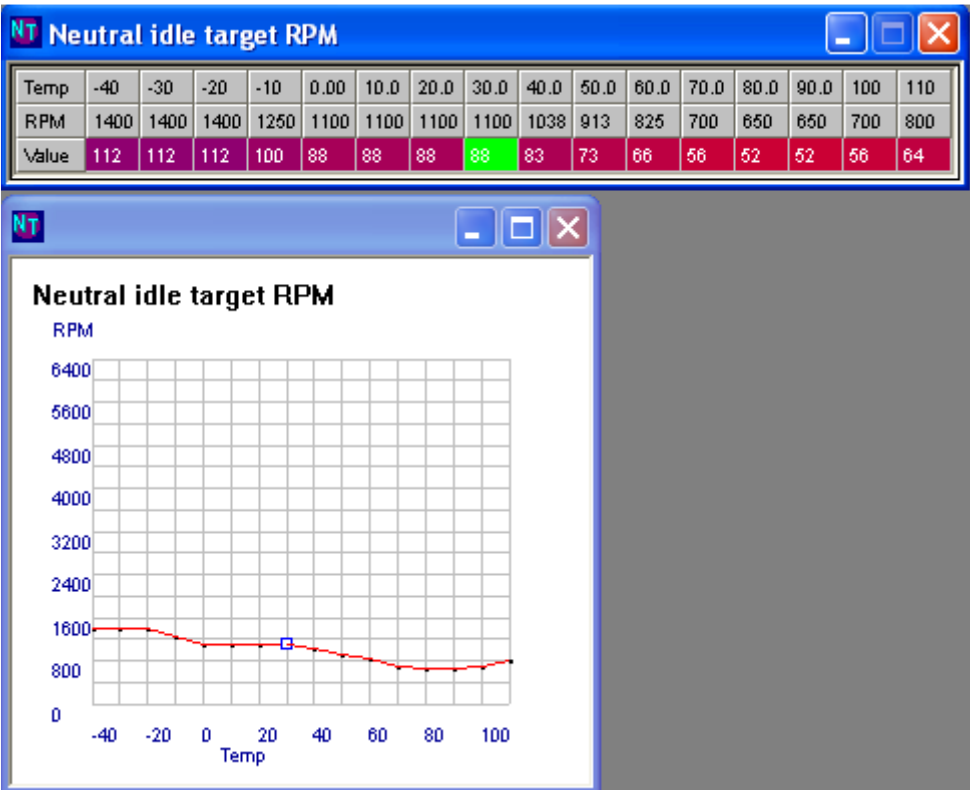


3. Idle Control

Description:  
Nissan ECUs control idle to maintain RPMs as per the Idle Speed RPM table below. The ECU will then adjust the timing to attempt to reach the desired RPM. This is the main thing which stops the car from stalling, and timing will be increased when RPMs start dropping below the values in this table. Noticeably as the engine is colder, the target idle RPM is higher.

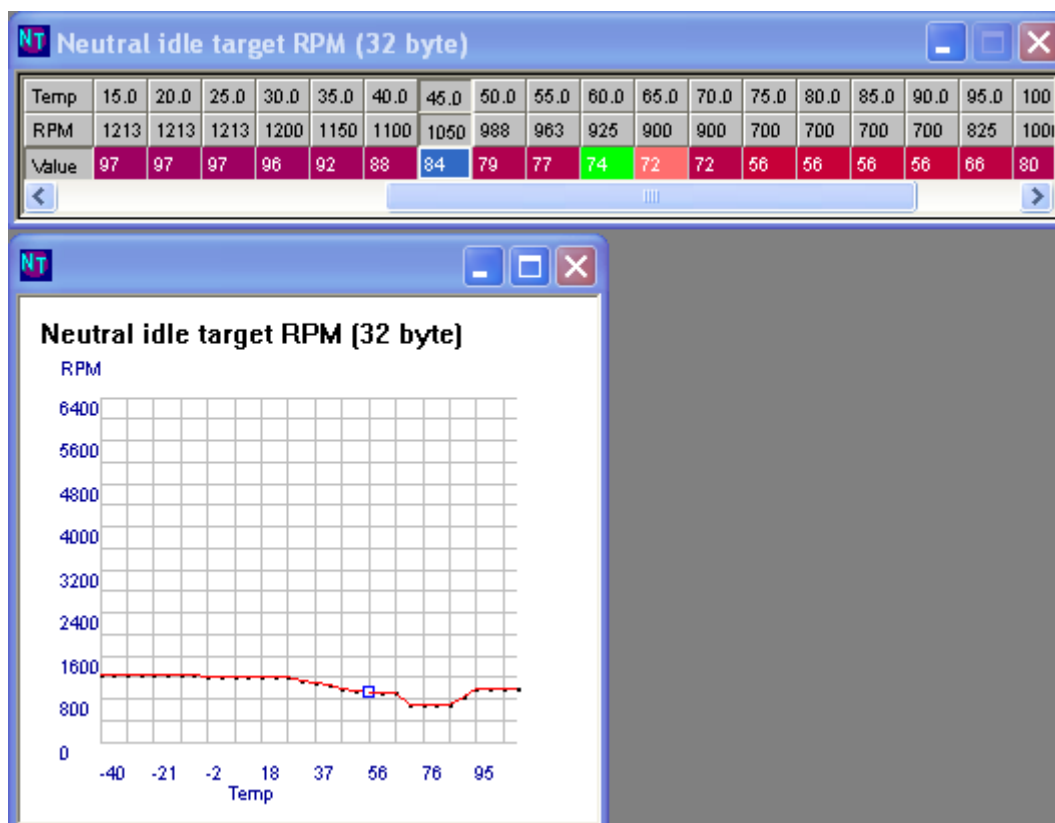
Idle operates in a 'closed loop' where it adjusts the AAC duty cycle and timing to maintain the target idle. Some ECUs may have AAC duty cycle tables available for adjustment (where they have been located and identified by Nistune)

Conditions:  
Idle Stabilisation tables are used when the TPS idle is on and adjust for timing advance and retard used to control the target idle RPM. Typically these should be left as is unless some extra advance or changes to limits is required to maintain idle.

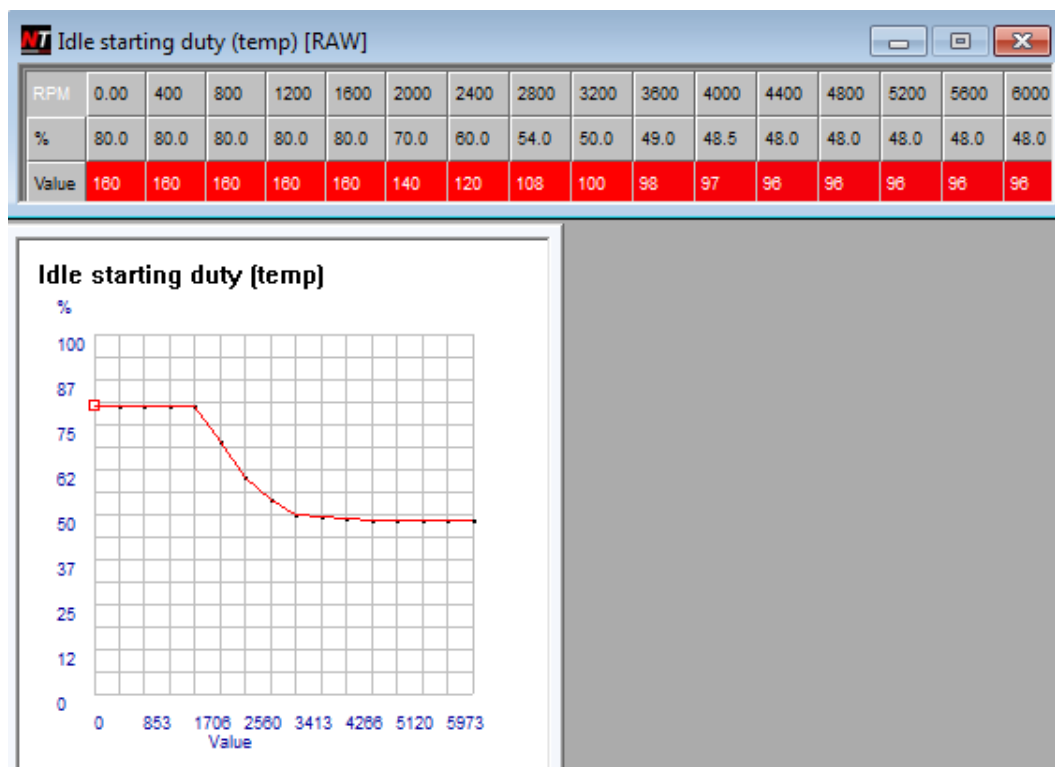


On this HCR32 the target RPM is about 650 when the engine is at operating temperature (about 85 degC)

Some ECUs have a 32 byte table which means it is twice as long, so has more resolution. Z32 300ZX for example has this as seen below



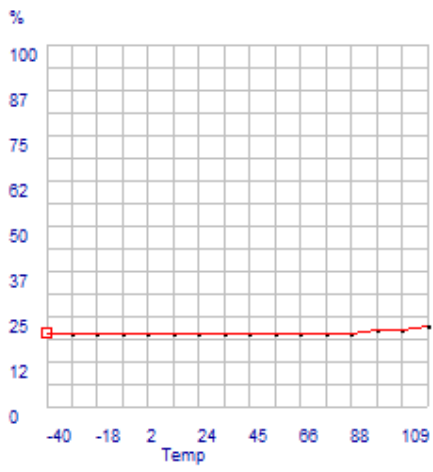
AAC duty after starting:



Indexed by temperature, duty cycle of the AAC valve is adjusted whether on / off idle and also if the air conditioner is used or not

NT Idle AC on duty [RAW]																
Temp	-40	-30	-20	-10	0.00	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100	110
%	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	21.0	21.0	22.0
Value	40	40	40	40	40	40	40	40	40	40	40	40	40	42	42	44

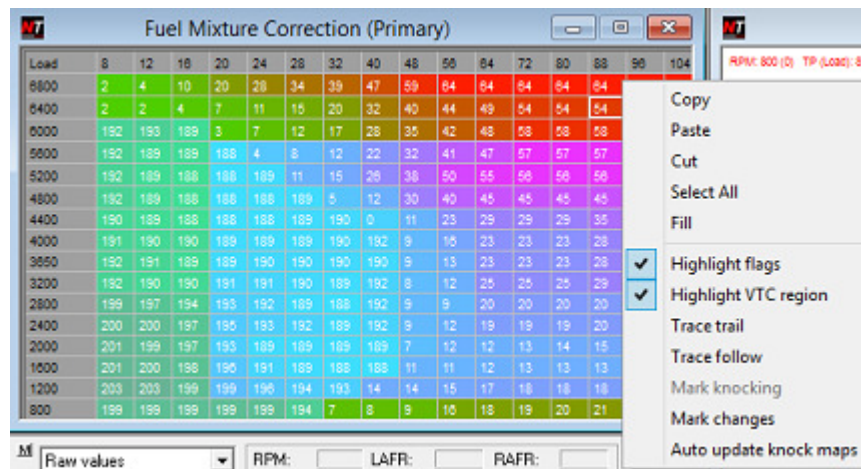
Idle AC on duty



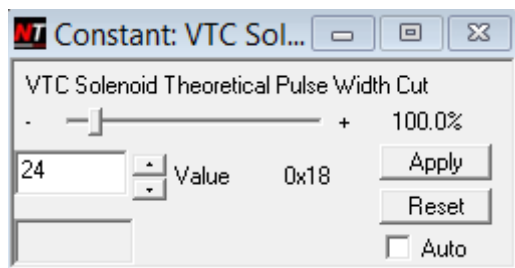
#### 4. Variable Cam Timing

Summary: Various models support Variable Cam Timing solenoid control. These include R33 Skyline, Z32 300ZX, S14/S15 200SX and R34 Skyline/WC34 Stagea

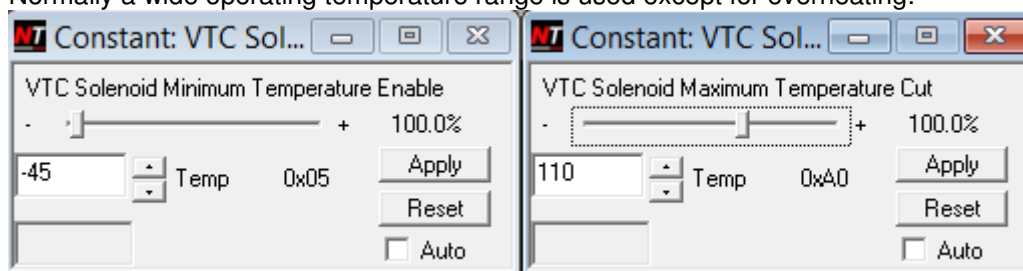
Note: There must be an active speed sensor input for VCT to operate



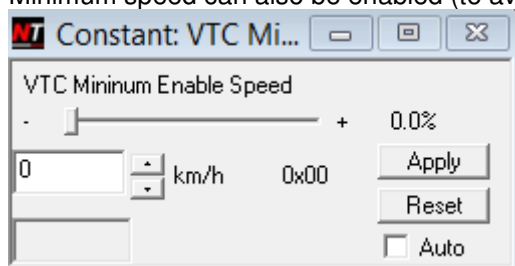
VCT will be operational from the minimum TP (load) plus hysteresis +10 to disable it again



Normally a wide operating temperature range is used except for overheating:

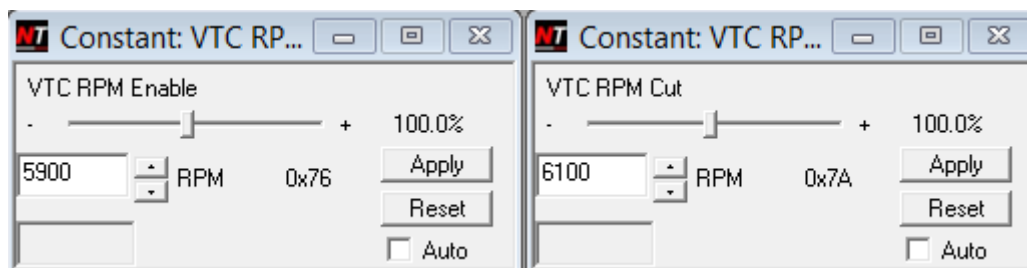


Minimum speed can also be enabled (to avoid VCT on low load at idle for example):



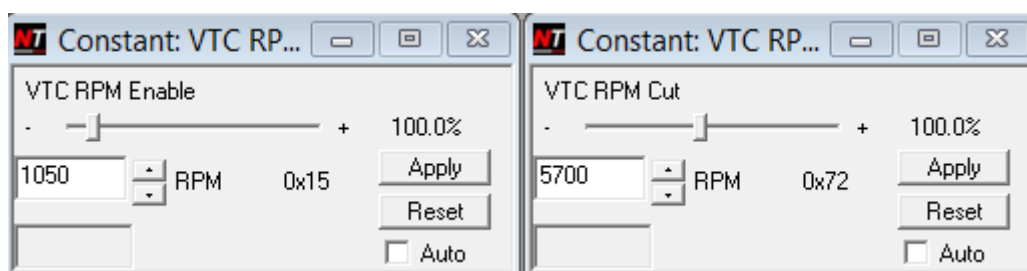
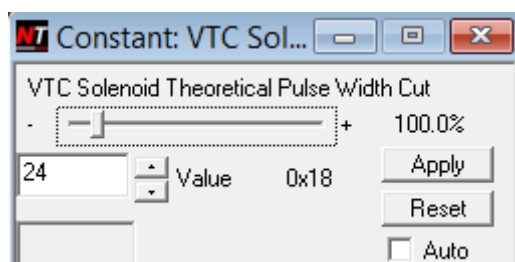
## Early VG/RB engines:

VCT will cut at the 'VTC RPM cut' point and re-enable at the 'VCT RPM enable' point when RPMs drop back down



## Later SR20 ECUs

Those SR20 ECUs with VCT from factory, or with VCT added using Feature Pack 1 will differ from the RB series ECUs which have a different RPM enable point



The VCT will be enabled at either  
(a) the reached minimum TP point  
(b) the reached minimum RPM point

If you wish to increase when VCT is enabled, it will be necessary to increase both of those parameters

The VCT will still be cut at the 'VTC RPM cut' point at high RPM, and reenable when RPMs have fallen below this parameter

## Operation

When the VCT is active this will be displayed on the Consult View panel in red:

Aircond sw	Cool Fan LHS
Pwr steer sw	Cool Fan RHS
Neutral sw	Pres reg sol
Start sw	W/gate sol
Aircond rly	FICD sol
Fuel pump rly	EGR sol
TPS idle	VTC sol

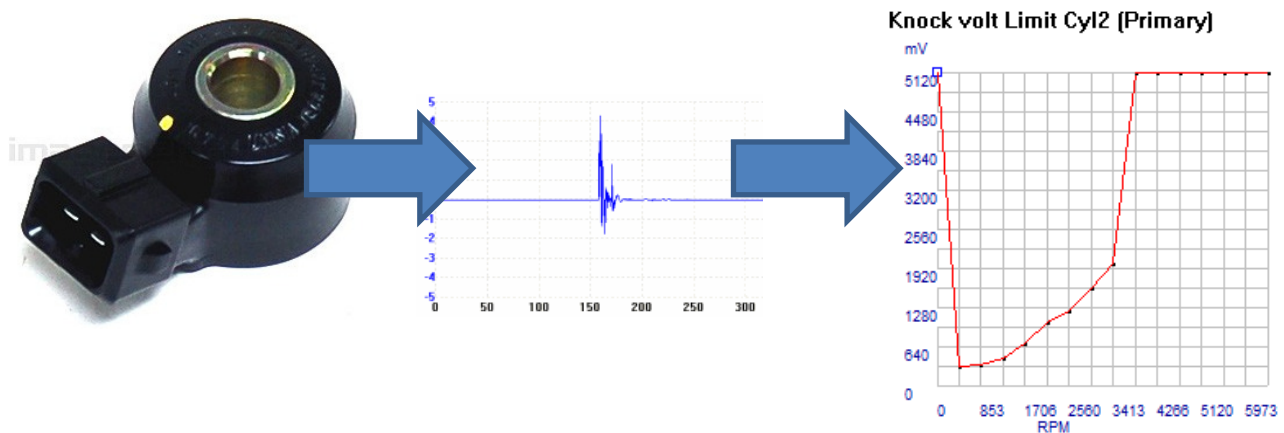
The output of the VCT from the ECU is active low. This means it will pull the line from floating to 0 volts. The other end of the solenoid should have ignition switch powered 12 volts.

*Note: S15 JDM ECUs will highlight the 'EGR SOL' indicator instead of 'VTC SOL' due to a change in ECU pinouts for these models compared to S15 ADM ECUs.*

## 5. Knock Control Sensing

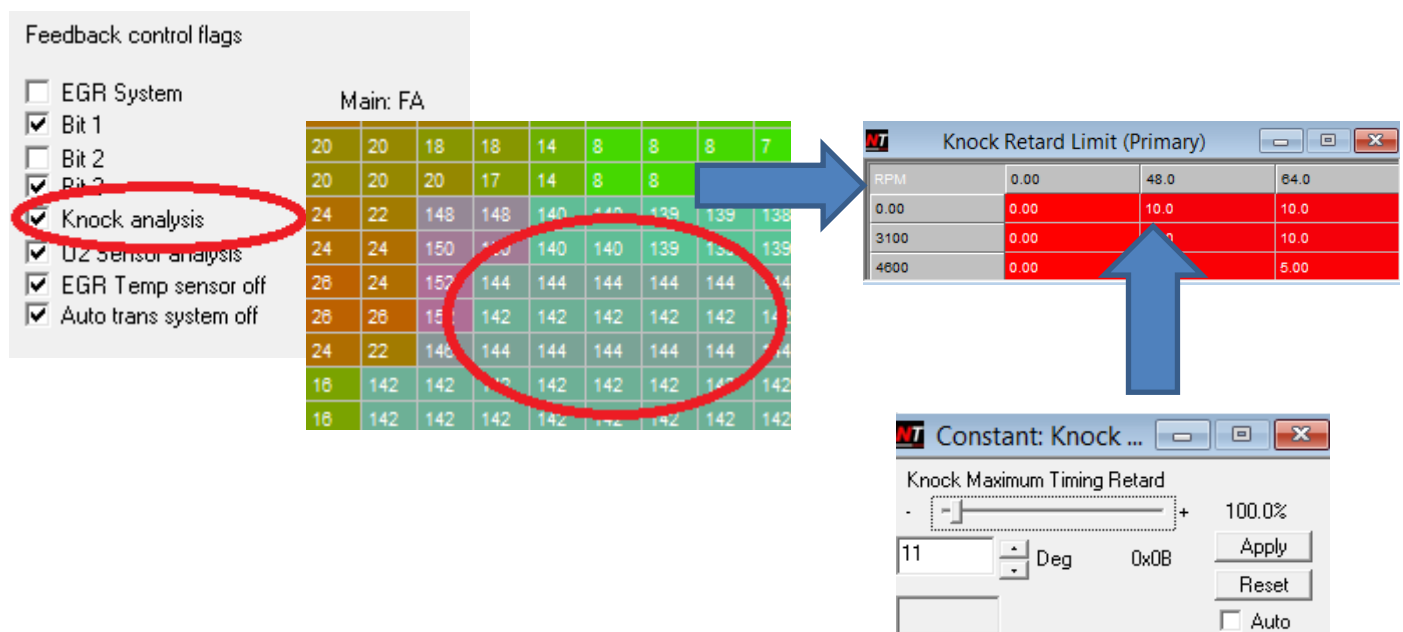
Earlier model ECUs use analog knock circuit boards which use an onboard narrowband filter to monitor for knock

Later model ECUs sample the knock sensor voltage and determine a noise level for each cylinder



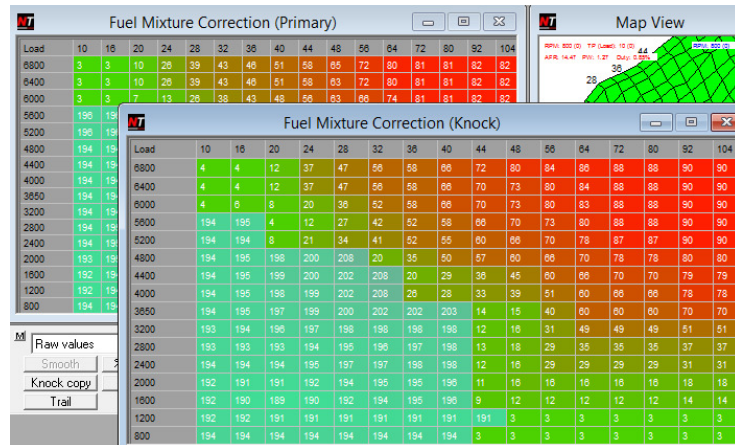
Once the limit has been exceeded the knock count increases.

When knock analysis is enabled, any knock counting occurring when in the knock area of the timing map will retard timing by knock retard lookup value upto the maximum retard value

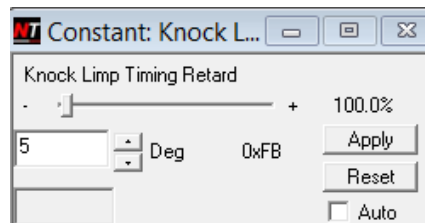




- When excessive knock is detected or the ECU knock fault is detected then the ECU will switch from primary knock and timing maps to knock maps



- When the knock sensor voltage is out of range then the ECU will retard ignition timing by the knock timing retard parameter. Refer to the Knock Sense technical notes for more information on this topic



## 6. Diagnosis and Reporting Tuning Issues

Determine if problem is

- Related to engine temperature
- Related to knock sensor input switching maps
- Related to misreported TPS idle (check idle status on Consult display) or misreported Neutral switch (check Neutral switch status on consult display)

Let us know your address file you are using

**Nistune [Z32(VG30DETT) Z32 (Version: 4)]**

Make sure you let us know the ECU part number you are using:

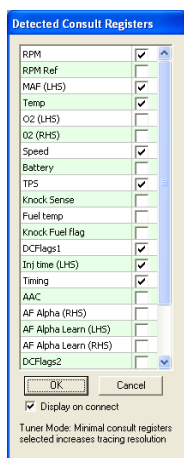
ECU: 23710-31P03

If you are using a Nistune board you will also see 'REV: number' next to the ECU part number. If you are using a Nistune board and not seeing this, your ECU has not been jumpered to use the board. Recheck your installation in this case.

### • Tuning Issues

Email us a log of the problem, and your BIN file which you are using so that we can replay it back here for further diagnosis

Click the items you want us to see



We require at least RPM, MAF, Temp, O2, Speed, TPS, DCFlags1, Injection Time and Timing to be recorded. If you are able to connect up a wideband unit, then you can also capture that in parallel with the log

For logging only (no changes) then click on 'Tuner mode' to change to 'Stream mode'



This will make the button red and greatly increases the sampling rate of sensor data from the ECU. But you wont be able to make any changes if using a Nistune board whilst doing this (change back to 'Tuner Mode' to make changes)



## 7. Logging

- **Recording**

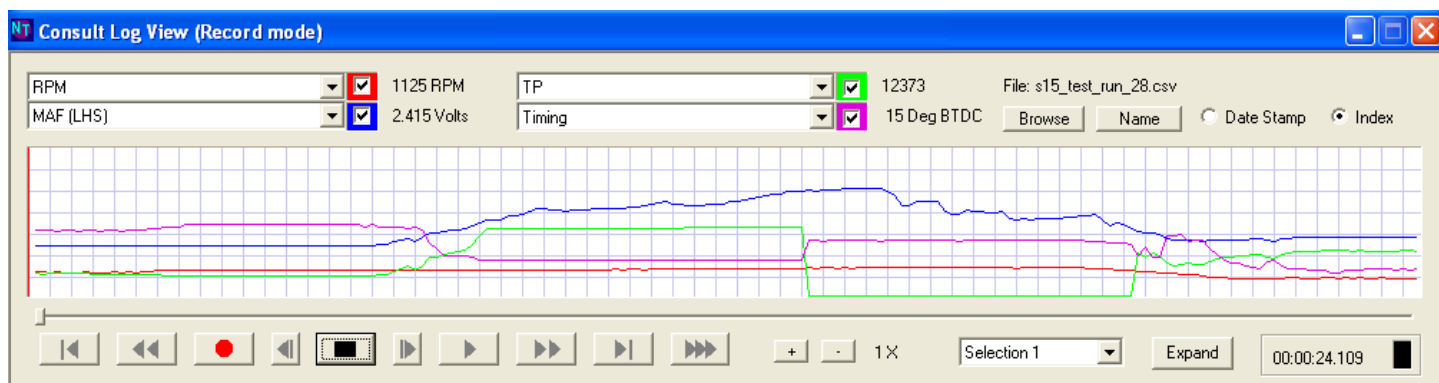


This button is your log button and will bring up the log player / recorder. There are two modes of operation – Record and Playback.

When you have input data (whether from consult or wideband devices) you will be put in Record mode.

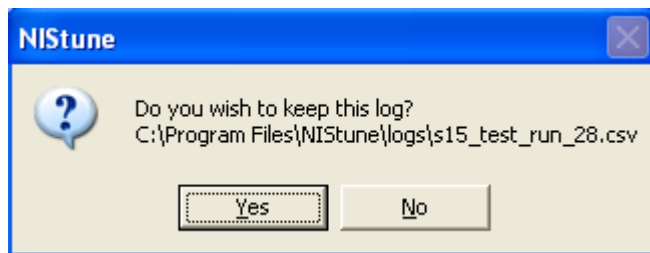
### Consult Log View (Record mode)

Record mode will begin to log information when you press the RED Record button and continue until you press the STOP button.



If you wish to continue logging simply press Record again and logging will continue to the current file. If you wish to save your log file, or record another log file then press STOP again.

All parameters are recorded (even the ones you cannot see on the display).

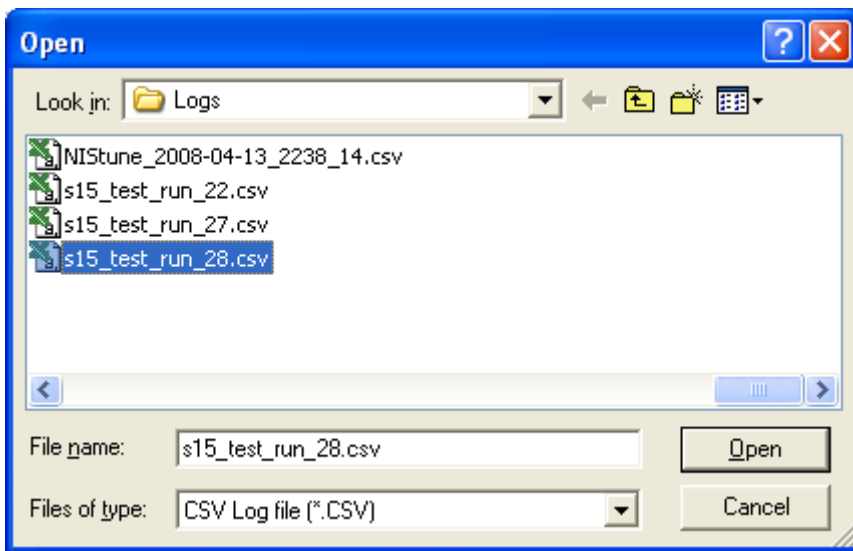


You will be prompted to save your log.

Once the file is saved you will be put back to Record mode again - with a blank screen ready to record more logs.

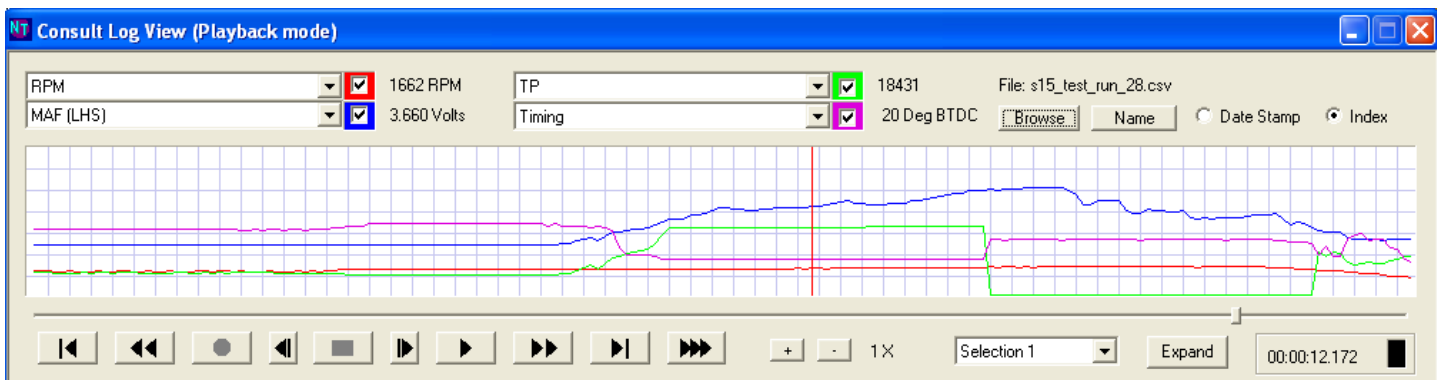
- **Playback**

To enter playback mode, either browse for the log file using  then select your file to playback:

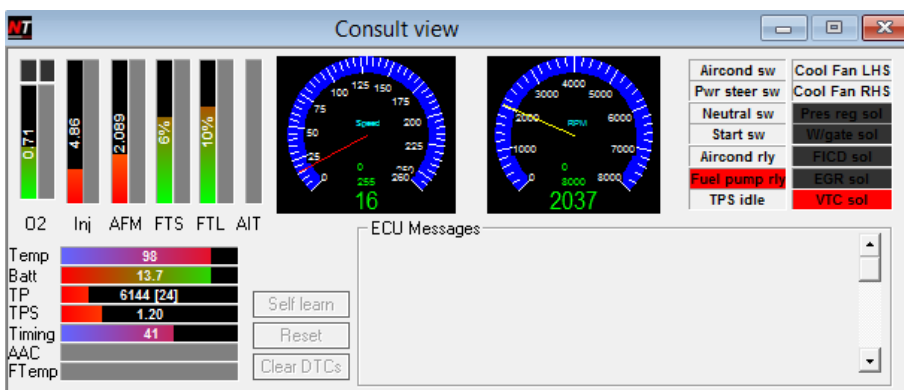


Or stop your input data by stopping Consult and/or Wideband.

Once in playback mode you can analyse or playback data:

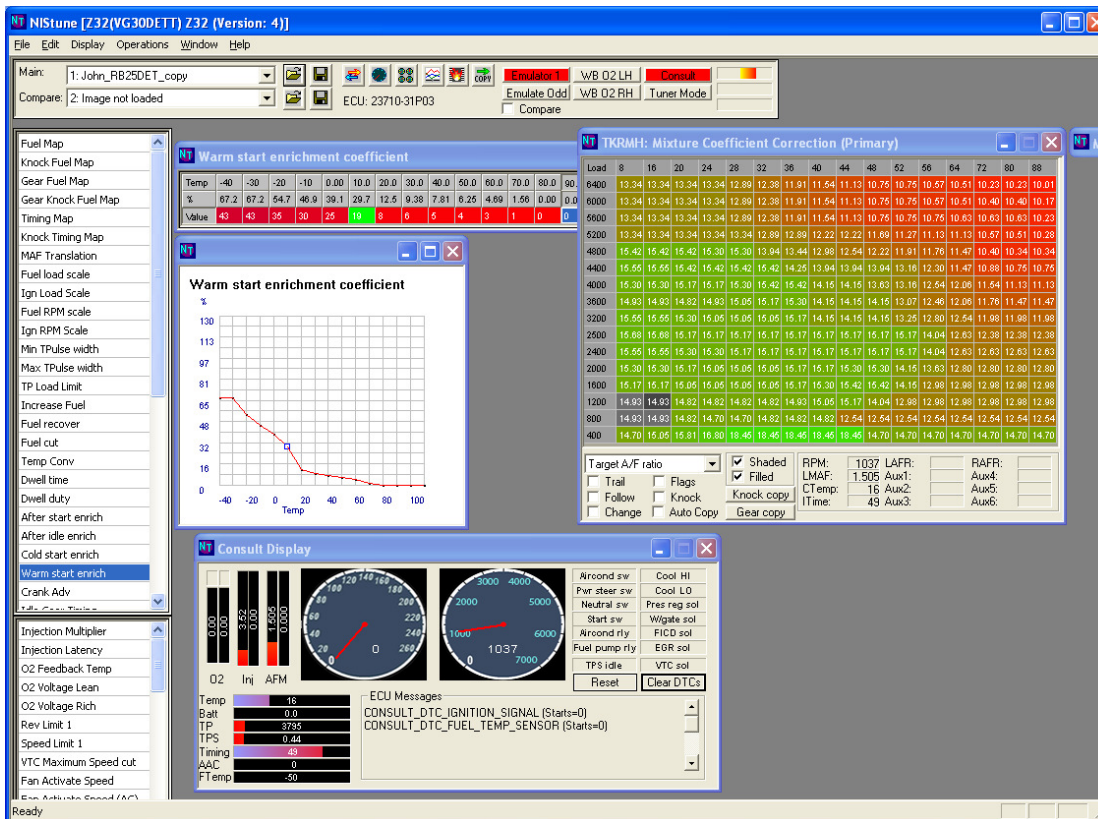


- 'Playback Mode' will be shown in the title bar.
- You can click on the graph to display current values and use CTRL LEFT / RIGHT to move the reference line.
- Pressing play will run through the log until the end.
- Clicking on the scrollbar will navigate around the log file.
- Select different parameters to display by using the drop-down menus.
- Nistune will show all the current parameters on the various displays, maptracing and gauges (including AFR tracing) same as if the vehicle was live.

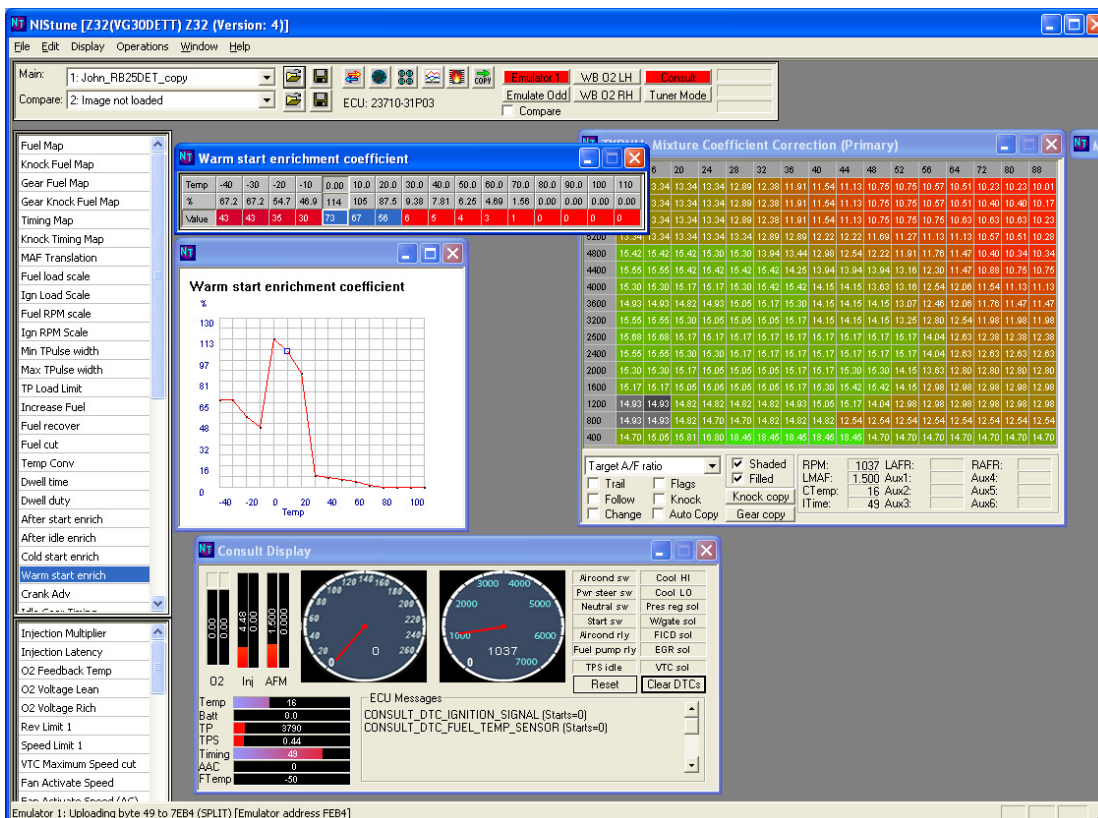


Note that DTC codes will NOT be played back.

## 8. Example - Cold / Warm Start Enrichment (bench testing results)



- Temp = 10 degC
- Injection pulsewidth = 3.52ms
- Warm Start Enrichment increased from 30% to 105% around 10 degrees.



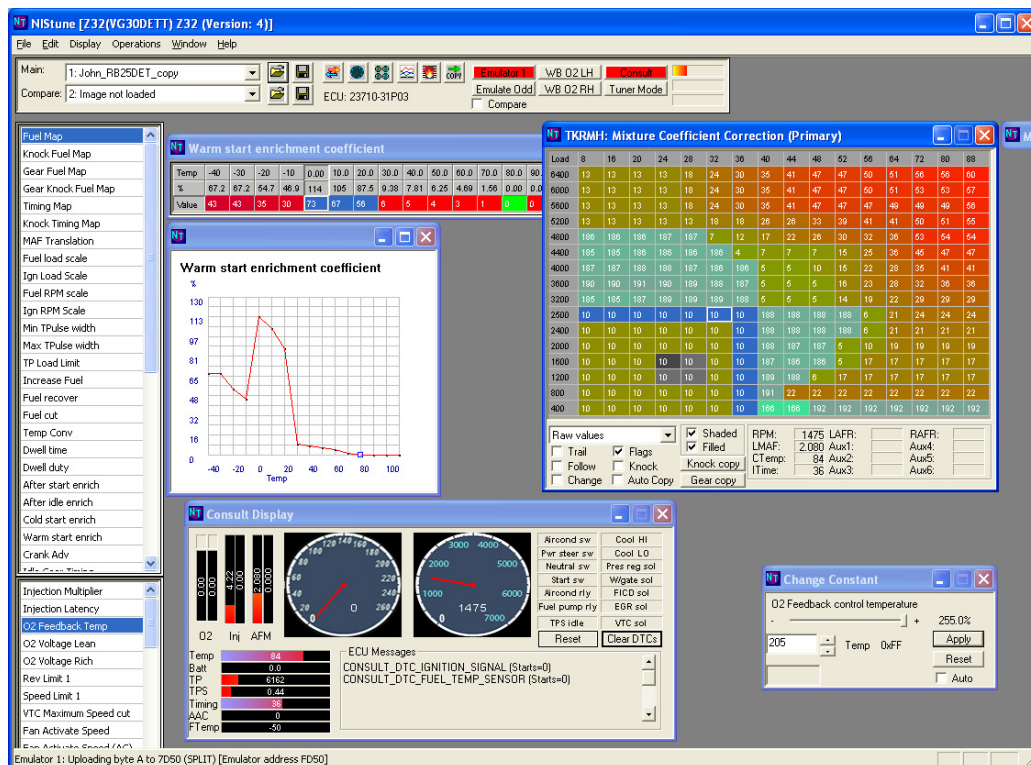
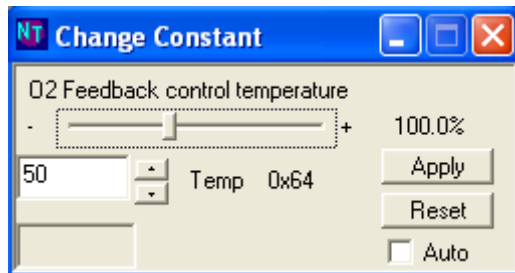
- Injection pulsewidth now = 4.50ms

## 9. Example - Diagnosing Fuel maps

Temp = ~80degC

Set fuel table to 0's

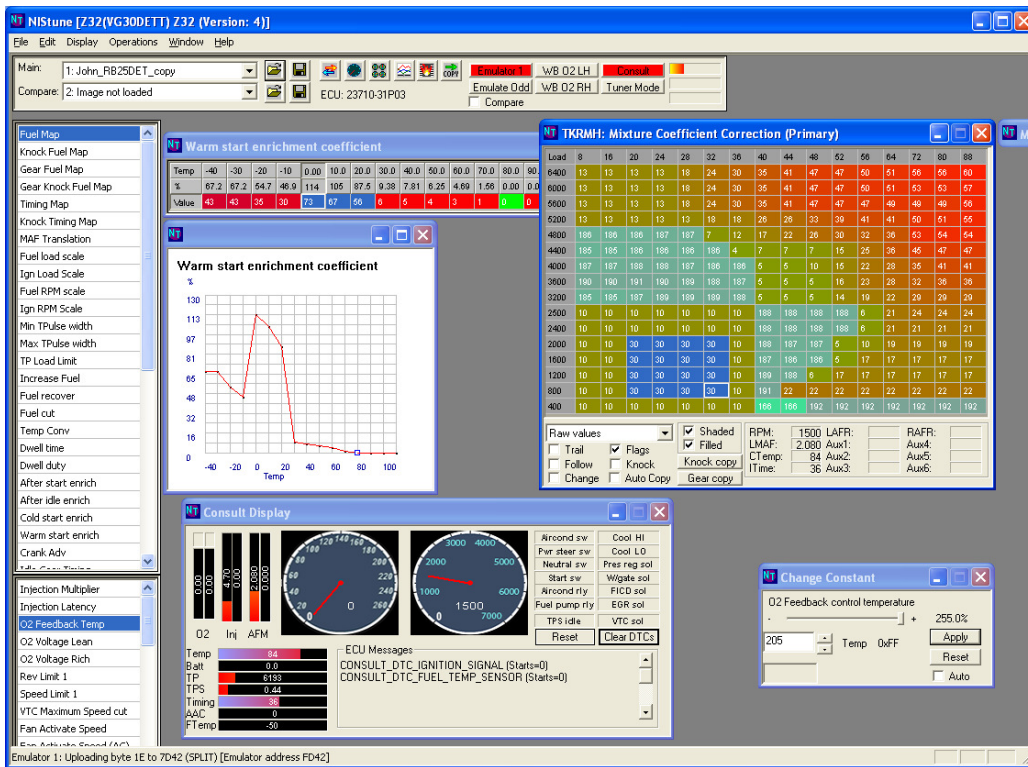
Increase O2 feedback temperature to 205 (Maximum) to disable the use of the O2 sensor (or disable O2 in feedback switches if available).



Pulse width in example is 4.22

Example: Increase fuel table to 30 around map-trace block





Check injection pulse width increases to 4.72ms (change due to alterations in fuel map)

If this doesn't work then try the Knock fuel map. Check your Knock sensor is connected (no knock DTC codes if connected should be raised).

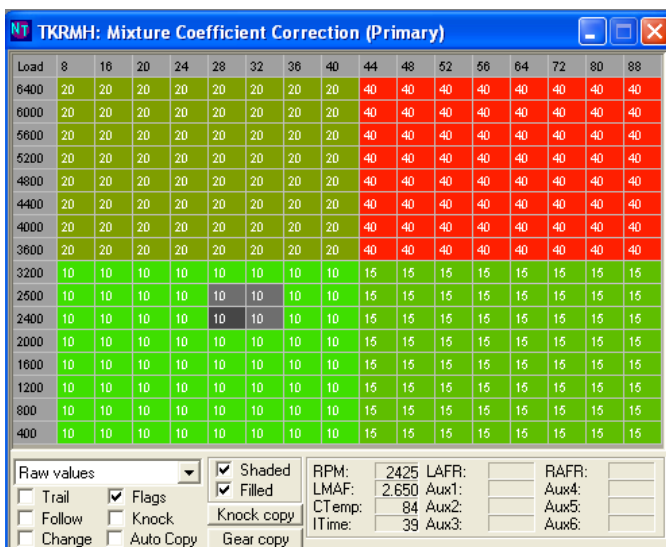
On Z32 ECUs also check your Gear fuel map and Gear Knock Fuel map. Check gear indication from A/T ECU or from 5th gear line (if available on manual ECU) is connected properly. You can also set the 'High Gear Coefficient' parameter for Z32 to 0 to not use the gear maps.

Check knock sensor is not picking up engine noise

- 1, Replace knock sensor with 570kohm resistor if suspect. This will simulate a good knock sensor input to the ECU without triggering diagnostic fault codes (DTC)
2. Disconnect sensor from engine and short to sensor ground using clips. This will raise a fault code (knock sensor out of limits) but will prevent knock inputs from being reported.

*Note: That whilst the concept of providing user switchable feedback may be possible by manipulating the knock sensor input, but one will need to watch the timing values when doing this.*

Further diagnosis then split the block into four areas with closed loop off



Move around each block and + / - the block and monitor the injection pulse width changes accordingly.

## REVISION HISTORY

<b>DATE</b>	<b>VERSION</b>	<b>DESCRIPTION</b>	<b>AUTHOR</b>
21 Apr 09	1.0	Document Creation	MB
24Jun10	1.1	Added TOC, start of general tidying	PL
11 Oct 14	1.2	Updated information in tables, new screenshots	MB
28 Nov 14	1.3	Added VCT and updated load naming	MB
9 Feb 18	1.4	Add new tables and maps. Clarify other points	MB