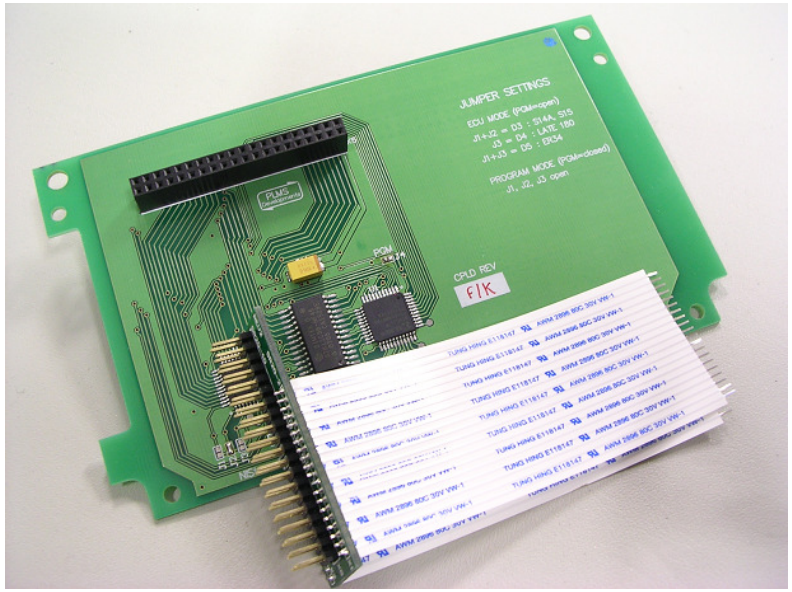
NISTUNE

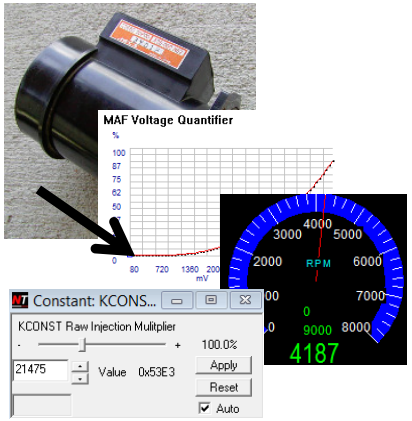
REALTIME ECU TUNING

Workshop Training Notes



Fuel Basics

Theoretical Pulsewidth



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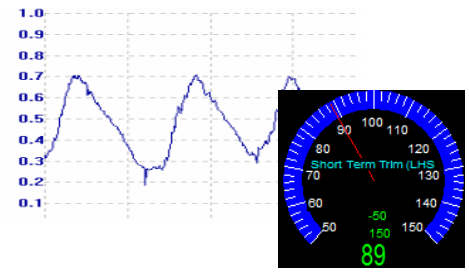
Short Term Trim
(Closed loop)



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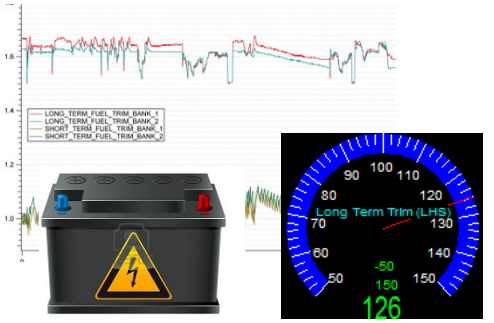
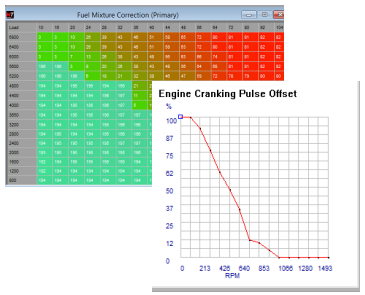
Long Term Trim (Stored)

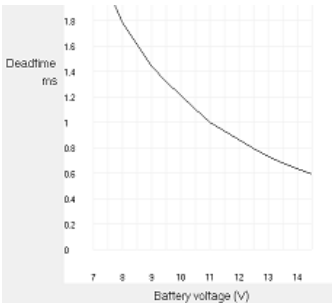


Total fuel calculations

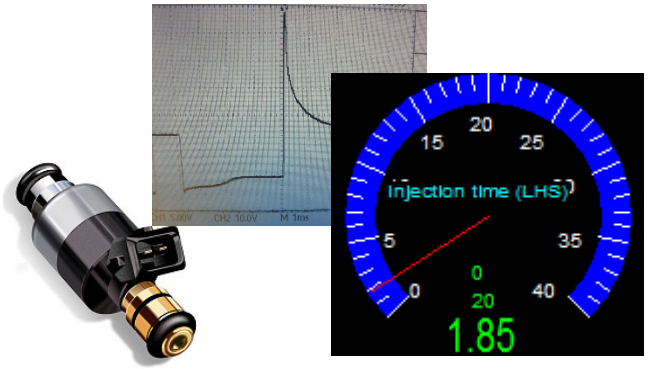
X



\+ Injector latency

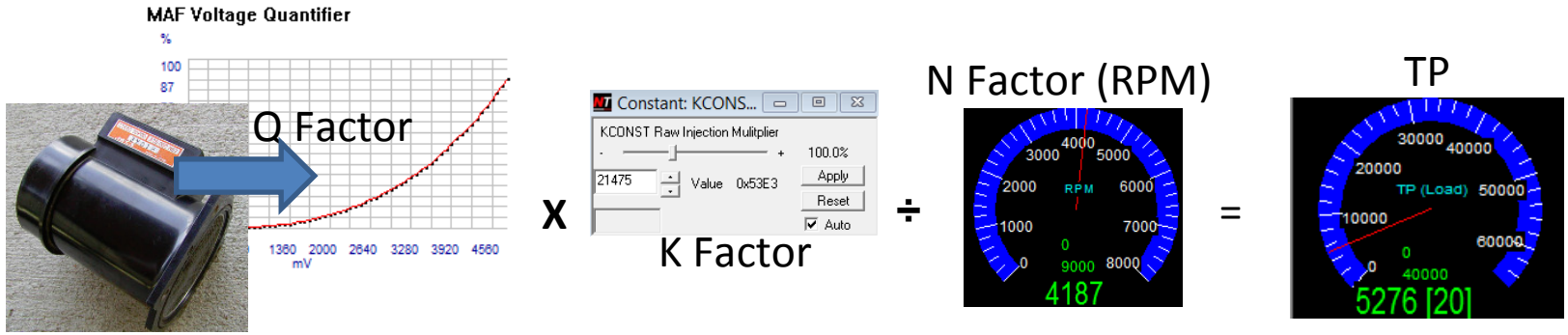


= Injector Pulsewidth



MAF Load Calculation (TP)

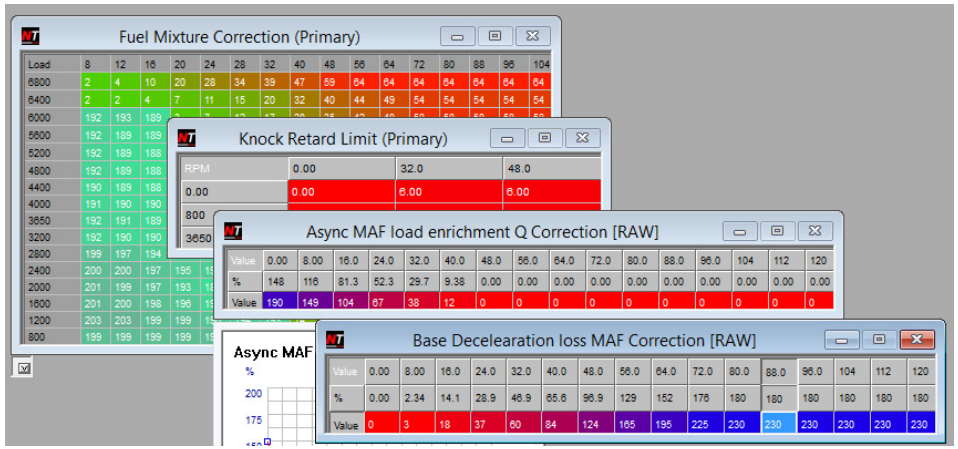
- TP = Theoretical Pulse width (MAF Load)



- MAF input and RPM are used to calculate final injector pulse width
- Load (TP) is a result of adjusting Load Multiplier (K constant)
- Load Multiplier is increased when MAF load has changed (upgraded MAF) or reduced when adjusting injection pulse width for different injectors
- Changing Load Multiplier affects indexing to any load related maps

Load (TP) Usage

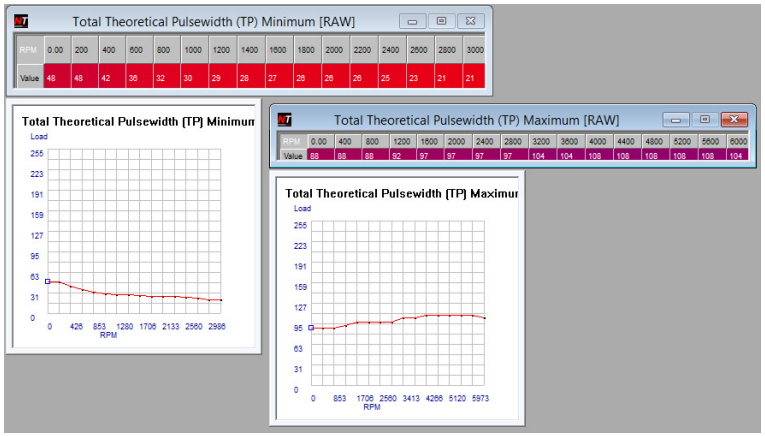
- Load (TP) index = Load (TP) / 256
- Used to index tables inside the Nissan ECU for fuel, timing, throttle enrichment, knock indexes, VTC etc



- Important : Where possible balance MAF and injector upgrades to keep Load Multiplier close to original value so the tune is not significantly affected

Total Load Min / Max Tables

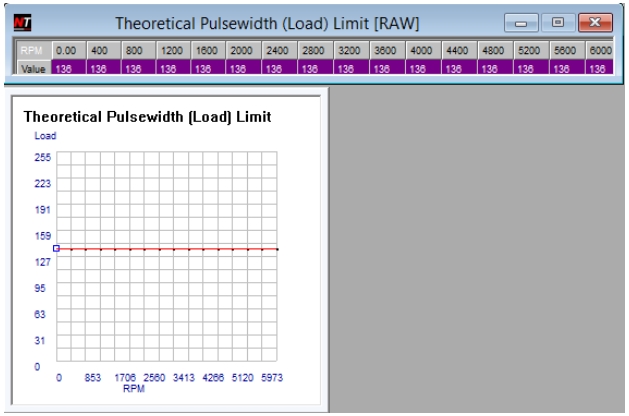
- The purpose of these tables is to accommodate for variances in airflow as a result of throttle movement during acceleration (TTP Max) and deceleration (TTP min)
- When adjusting for larger injectors these limits can create an undesired injection floor and ceiling which result in limited AFRs when tuning a vehicle

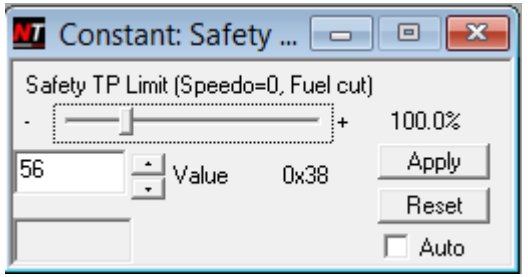


- During injection resize Nistune offers an option to automatically adjust these tables. It is suggested that these tables are trimmed back during further tuning.

Load Limit Table (TP cut)

- Also known as ‘boost cut table’ this table sets the maximum allowable load when there is a valid speed input above 0 km/h
- Increase this table when boost is increased on the vehicle or load has been adjusted by changing Load Multiplier (K). Setting to maximum is not recommended as it removes ECU over boost protection
- Some vehicles also have a TP recovery table where injection will resume following a cut at the specified TP for the specified RPM index in the table

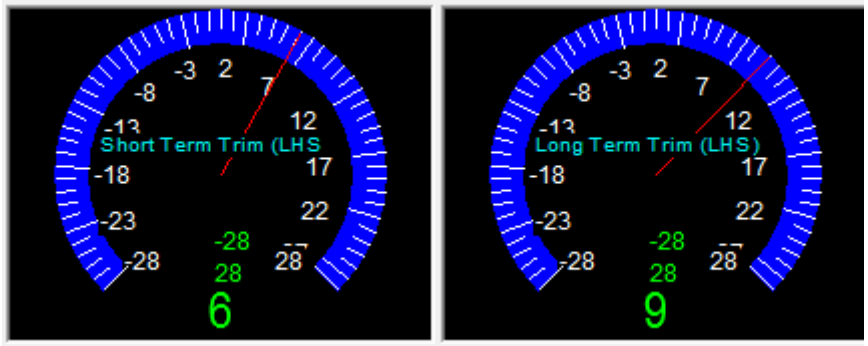


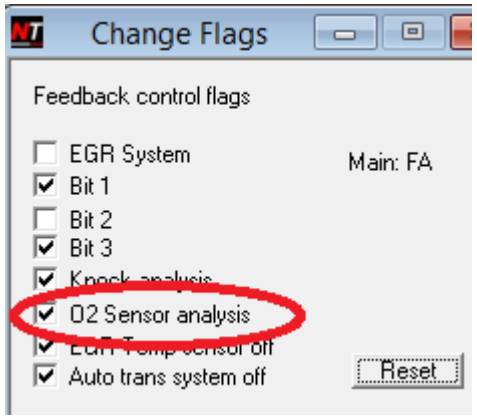


- For vehicles with no speed input a safety TP limit (and RPM limit) will be used instead.

AF Alpha Trimming

- Short and Long term trims are referred to as AF Alpha internally by Nissan as the factors which adjust the final injection pulsewidth

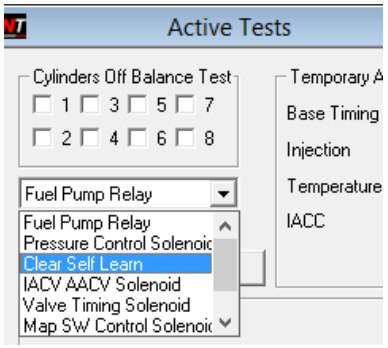


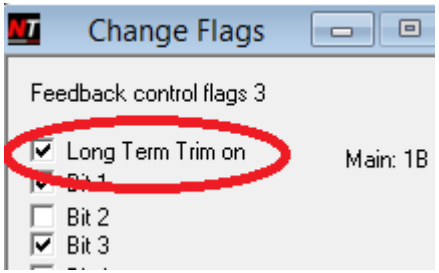


- Previous short and long term trim values are used even after O2 analysis is disabled
- When O2 analysis is enabled short term trims will be adjusted by the ECU based on the trimming compensation required to maintain stoichometric air fuel ratios

AF Alpha Trimming (cont)

- 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 clear trimming to 0%

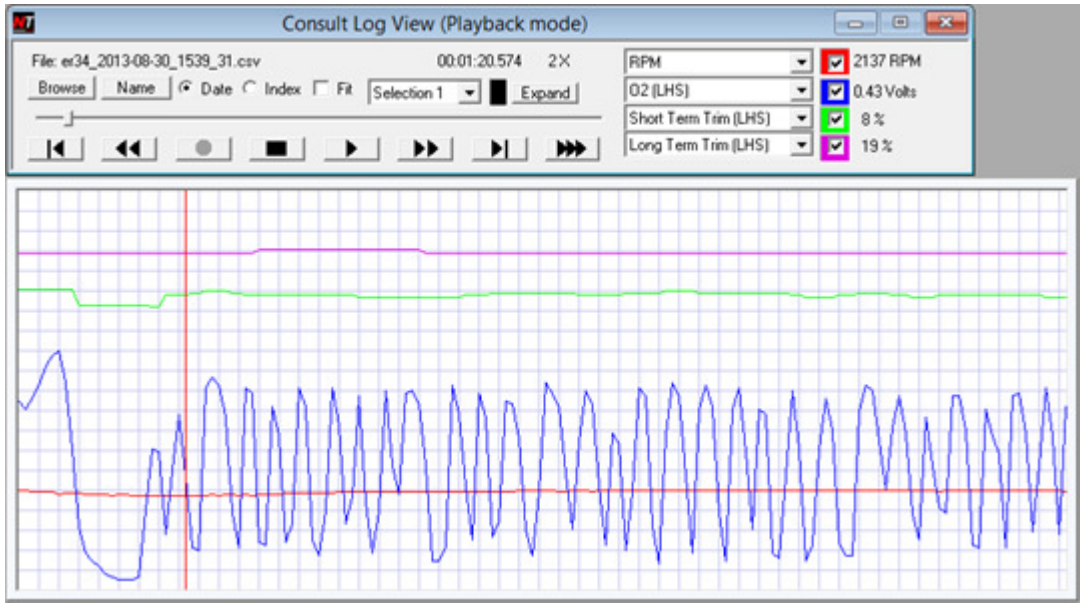




- AF Alpha short and long term trimming factors will be used regardless if ECU currently in closed loop parts of the map. Can be disabled in some Nissan ECUs
- Ensure correct O2 sensor functionality before performing a tune otherwise there may be resultant undesirable trim adjustments

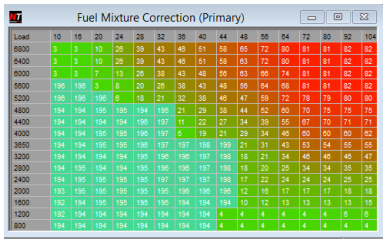
AF Alpha Trimming (cont)

- Use the log viewer to monitor O2 sensor oscillation and short and long term trim adjustments



- During tuning keep Long Term trim at 100%, reset the trim if required. Tuning adjustments should ensure that short term trim stays around 100%

Total Fuel Calculations



Fuel values

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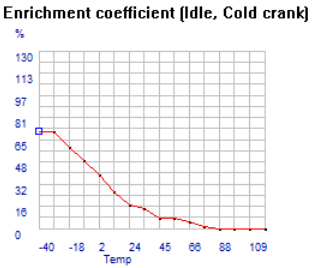

Warmup Temp Enrichment

(Not closed loop)

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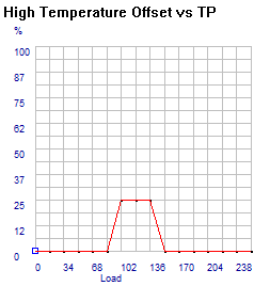
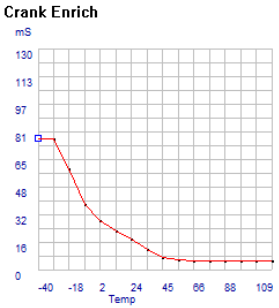


Over temp enrichment



Crank Enrichment

(During crank)

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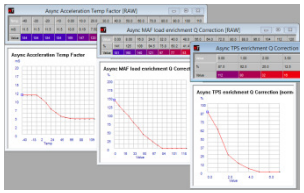
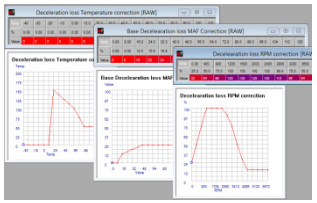


Accel Enrichment

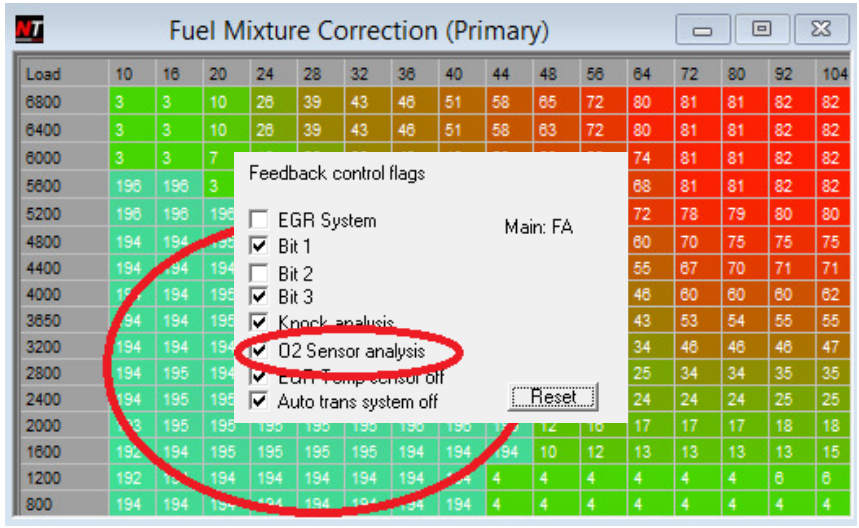
-



Decel Enrichment

Fuel: Fuel Map Values

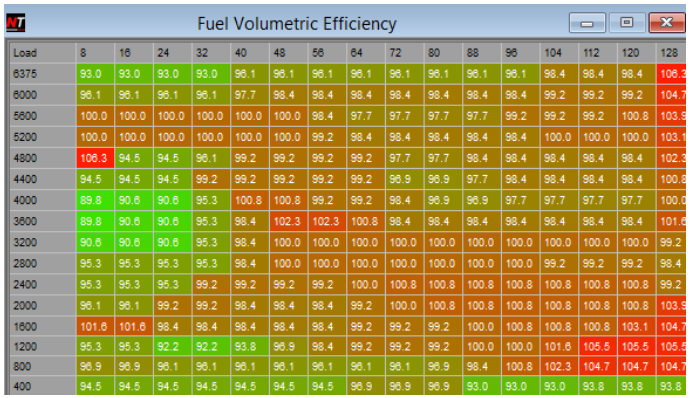
- Nissan fuel maps for early models split the fuel map into two parts

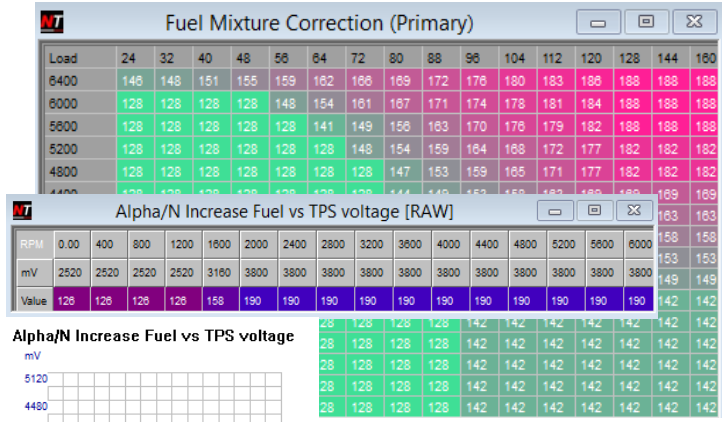


- **First scan coefficient**: Cells < 128 or disabled O2 anlaysis will use the default AF alpha trim value of 100%
- **Second scan coefficient**: Cells >= 128 indicate ECU operating in closed loop region and when closed loop is enabled the O2 sensor voltages are monitored and adjustments made to short term trims (AF Alpha)
- Nistune differentiates the cells using aqua colour for closed loop. Cell value changes adjust the fueling coefficient used as part of the total fuel calculation used by the ECU

Fuel: Fuel and VE Map Values

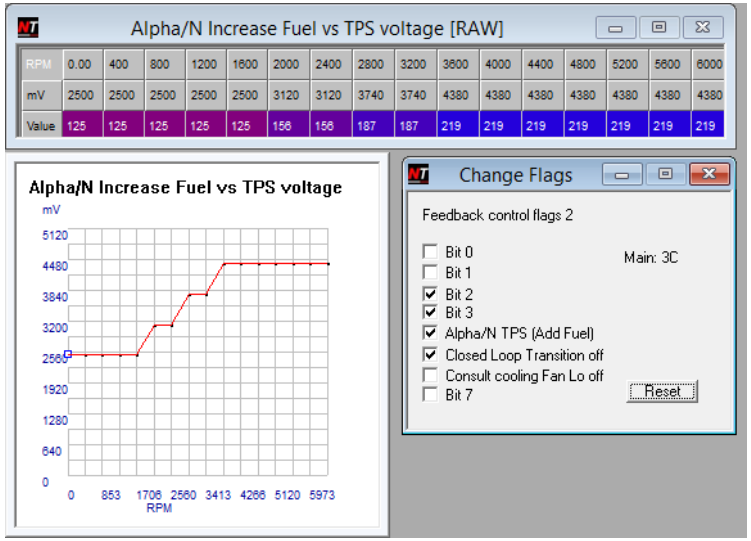
- Later model ECUs split the two coefficient scans into separate tables
- **First scan coefficient:** Fuel table read. Values of 128 define the closed loop area
- **Second scan coefficient:** When the TPS is below the Alpha/N limit the volumetric efficiency referenced value is added to fuel map value

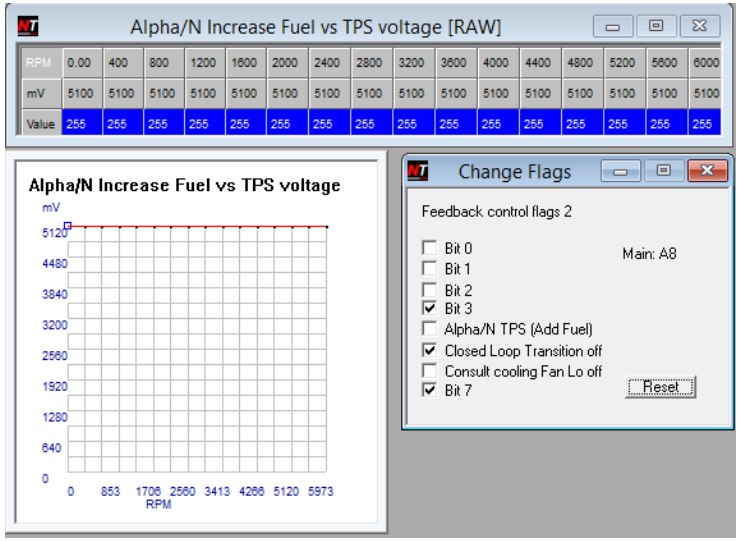




Fuel: Fuel Alpha N Mode

- 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)

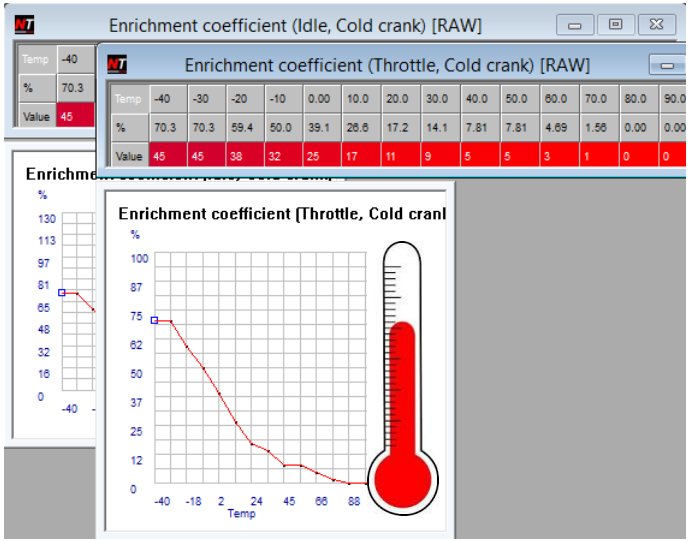




Images: AlphaN TPS B13 Sentra SR20DE enabled and S13 SR20DET disabled

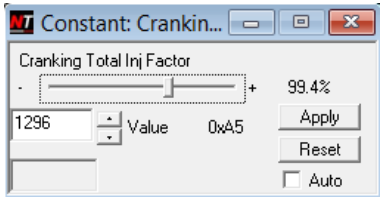
Fuel: Coolant Temp Enrichment

- Operates when not in closed loop
- 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

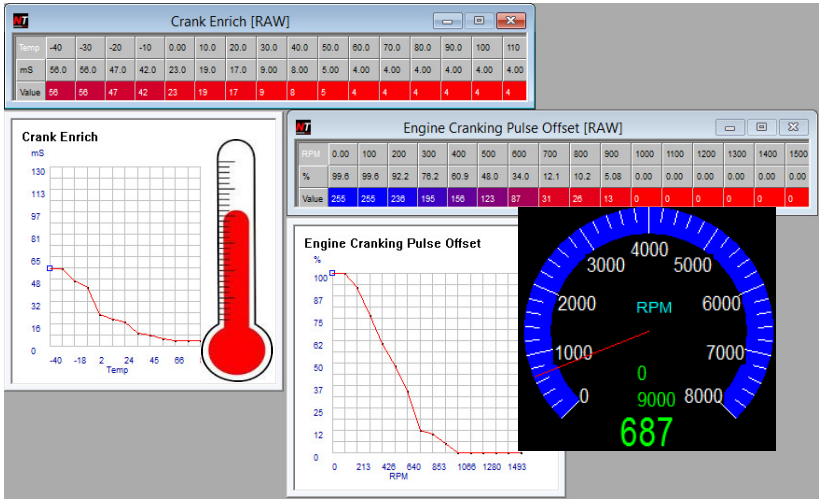


Fuel: Cranking Enrichment

- Used when vehicle is cranking (ECU sees start switch active)
- Crank Enrich (vs Temp) multiplied by Cranking Pulse (vs RPM) and cranking factor



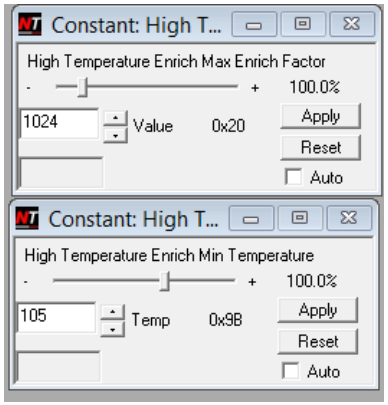
X

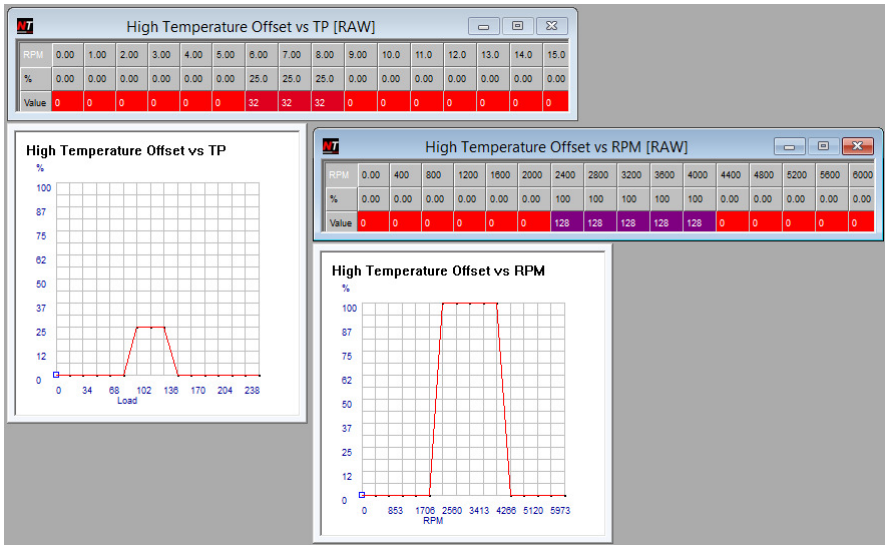


- Note: Decrease cranking tables or cranking factor when resizing injectors to prevent overfueling during cranking

Fuel: High Coolant Temp Enrichment

- The Nissan ECU 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

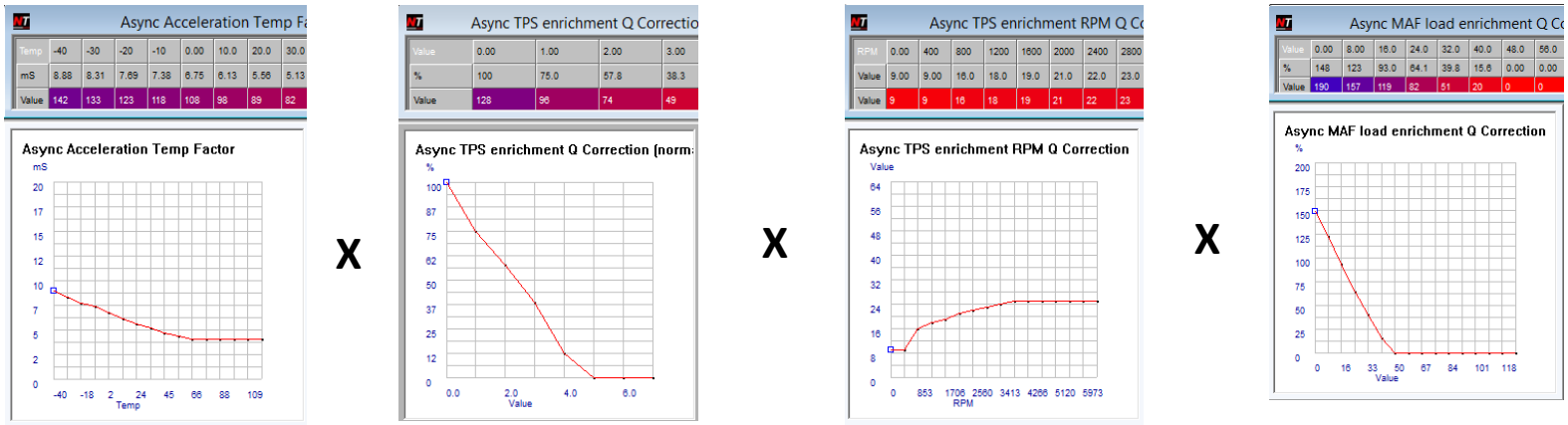




- Not all ECUs use these this additional enrichment

Fuel: Accelerator Enrichment (Async)

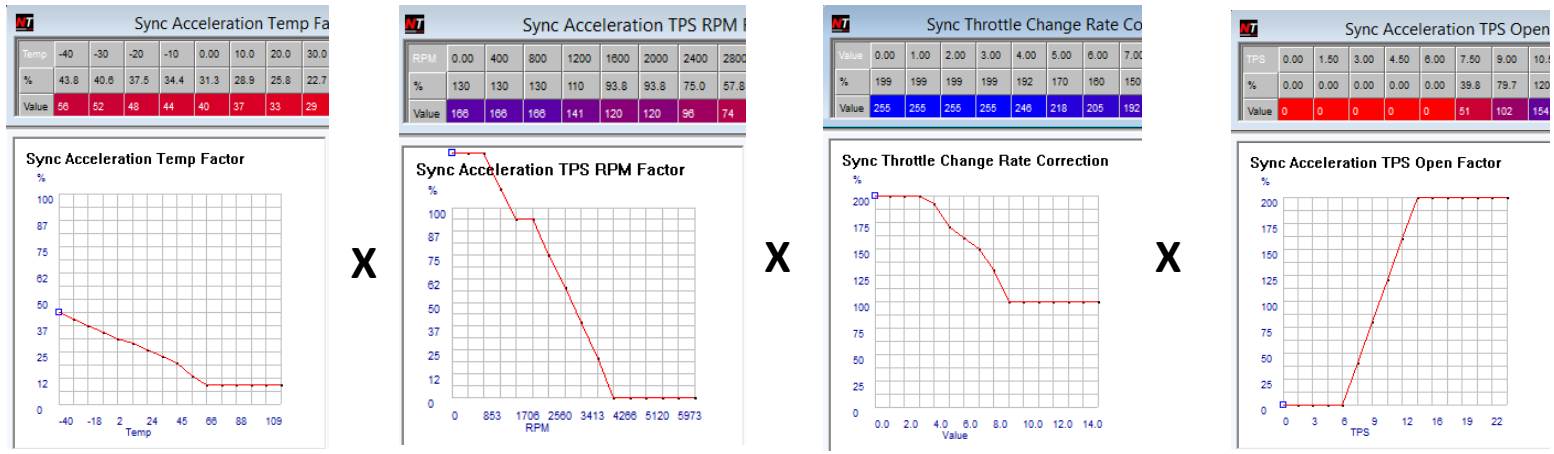
- When throttle opened at certain rate, additional throttle enrichment is added based on the following tables



- Temperature table contains the base enrichment (ms) and then adjusted by TPS rate, RPM and MAF (TP) load
- Valid from 600rpm – 3200rpm (Async min – Async max RPM)

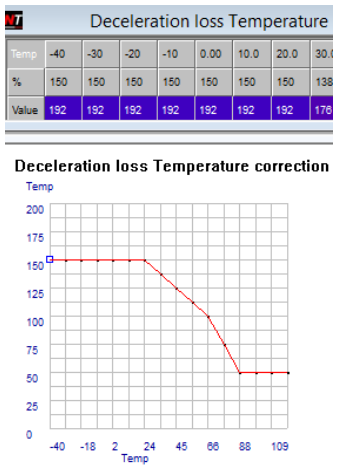
Fuel: Accelerator Enrichment (Sync)

- Used when throttle opening above certain rate to add extra enrichment
- Tables indexed by coolant temperature, RPM and TPS rate



Fuel: Deceleration Reduction

- Used during throttle closing when decelerating to reduce injection time
- Tables indexed by coolant temperature, RPM and MAF voltage



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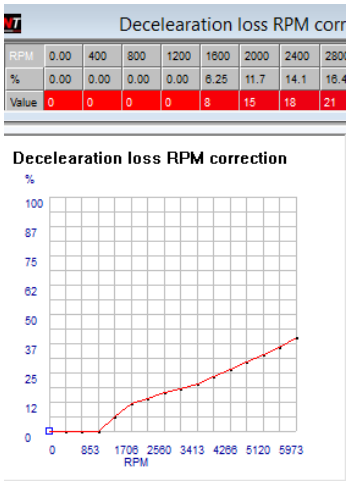

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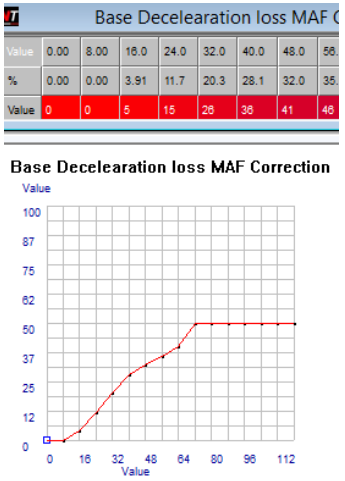
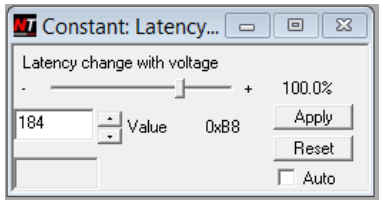


Injector Latency

Total injection latency =

Battery Compensation
(14V – current voltage)

X



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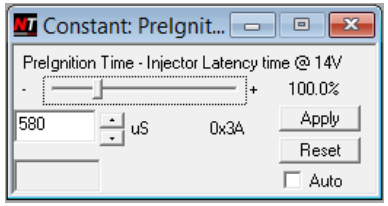


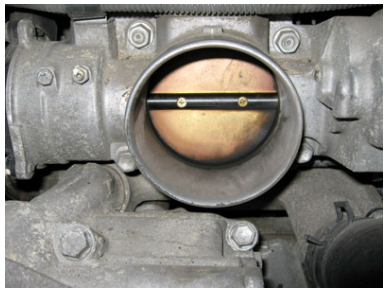
This is added to the total injection pulse width. Changes to injectors must have the latency value @ 14 volts adjusted.

Ignition Timing

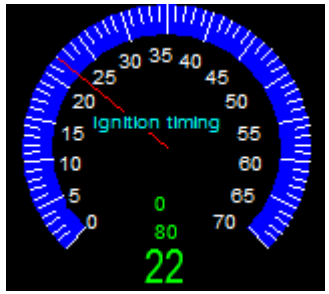
There are three sources of ignition timing, depending on vehicle operation:

Crank Timing

Throttle Closed (TPS Idle) Timing

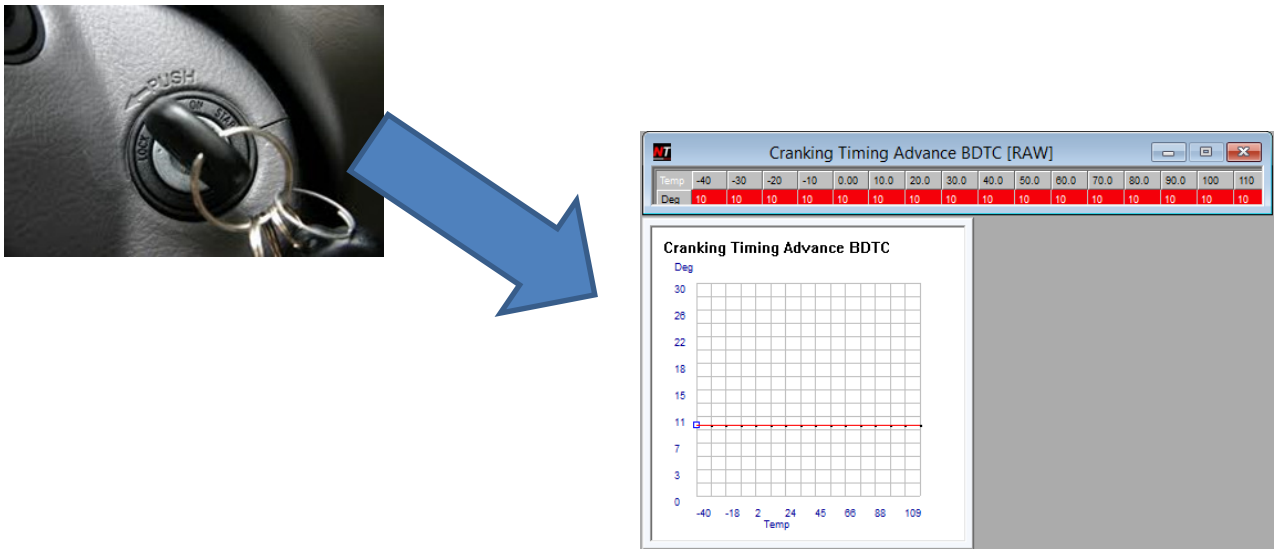


Throttle Open Timing



Crank Timing

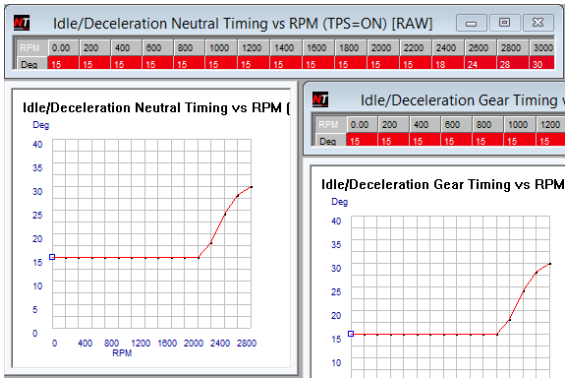
- When the ECU detects the ‘start’ signal input it will use the crank timing table. This table is indexed by coolant temperature



Idle Timing (Throttle closed)

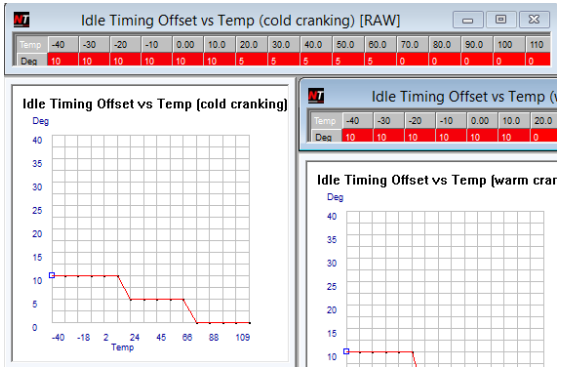
When the vehicle is idle or decelerating, the idle timing tables are referenced based on current engine RPM

Note: Some vehicles will have multiple tables which are neutral / gear and air conditioner dependent



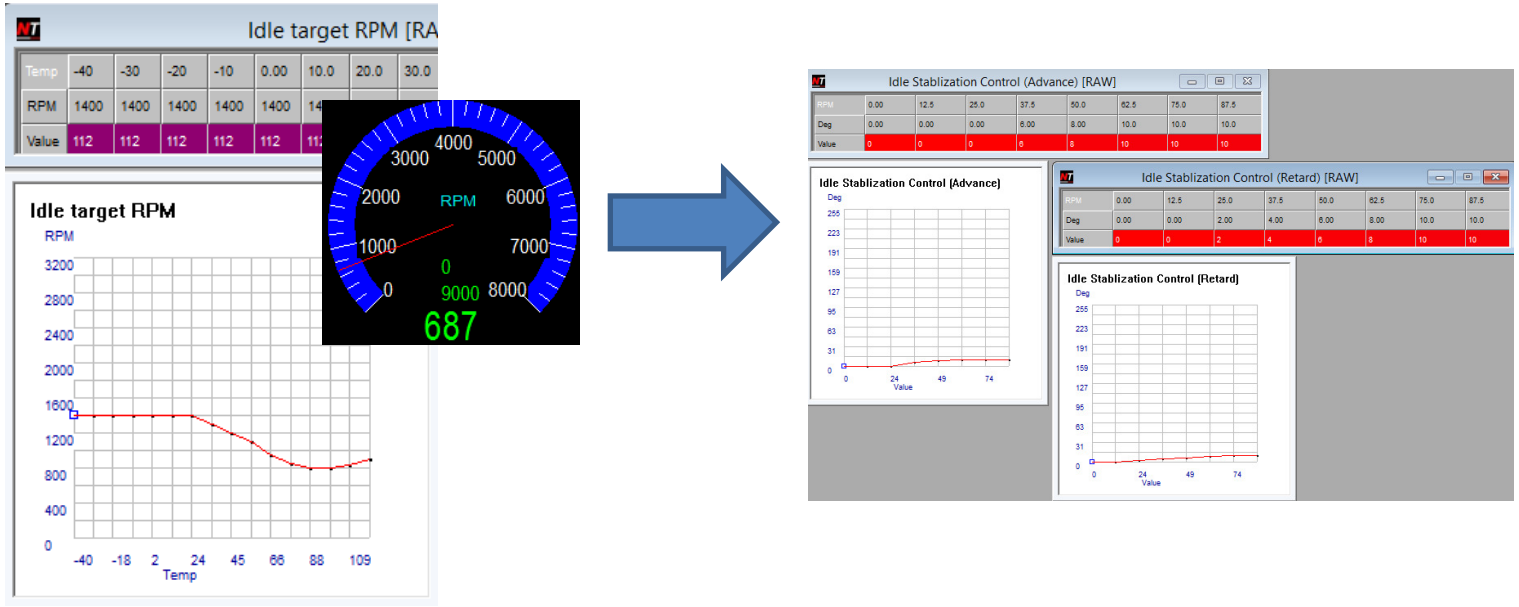
An additional trim based on coolant temperature is applied

Note: Some vehicles will have multiple tables which are accessed dependent on the coolant temperature at the time of cranking



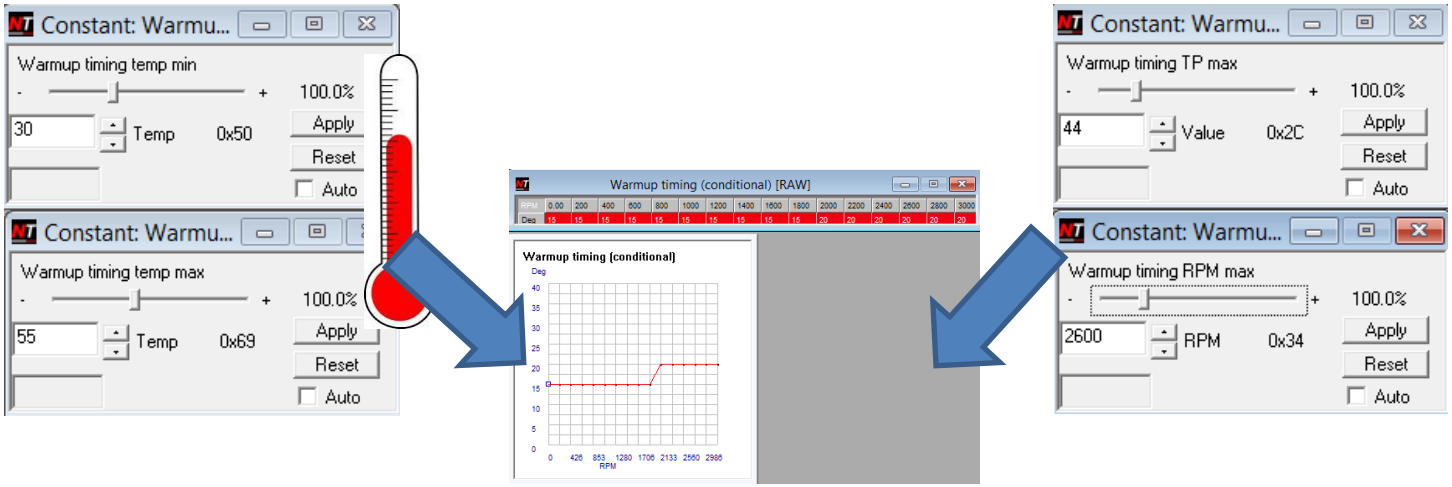
Idle Timing (Target RPM)

- Idle timing is further adjusted based on differnece between current and target RPM
- Idle stablisation stables are used to advance and retard the timing based on this difference



Throttle Open Timing (Warmup)

- Throttle open timing will depend on vehicle and current operating inputs
- Some vehicles have conditionally used warmup timing tables (CA18, RB, VG30 engines). Others use the Idle Timing maps (SR20 engines)
- Warmup temperature range typically 30 ~ 55 degC
- Changes to TP may require adjusting warmup timing ranges to prevent unwanted access to this table during warmup

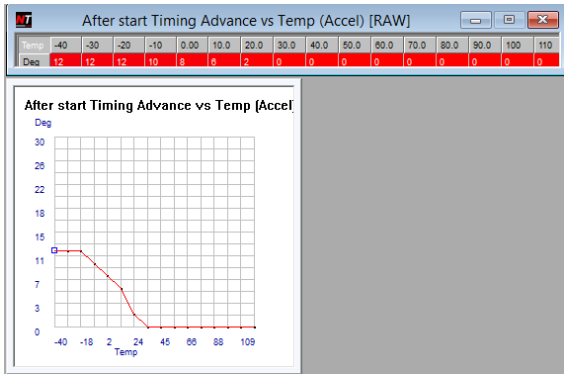


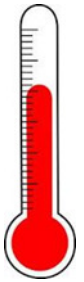
Throttle Open Timing (Normal)

When warmup tables are not being used (typically below 30degC) then

1. Extra timing is added using the after start timing advance offset tables

2. Ignition timing maps are accessed





Timing is displayed in degrees BDTC

Values displayed with light blue shading represent knock monitoring areas in the timing map. These have 128 added to the actual timing value

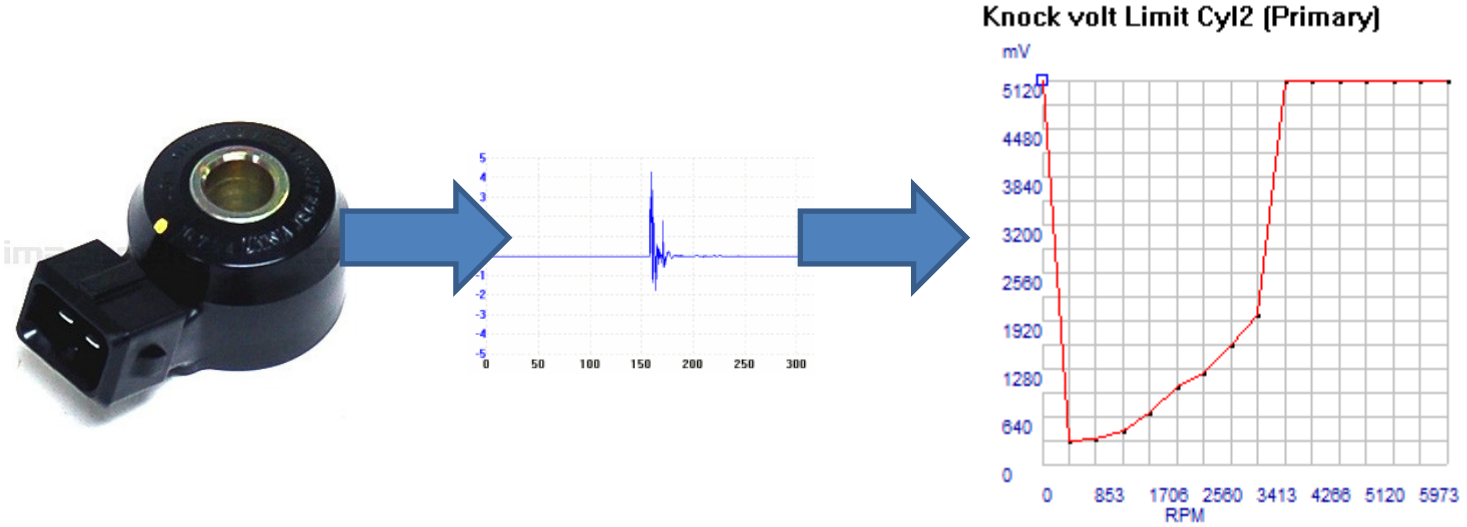
Viewing in filtered mode will normalise the ECU data display

Ignition Timing (Primary)

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

Knock Control Sensing

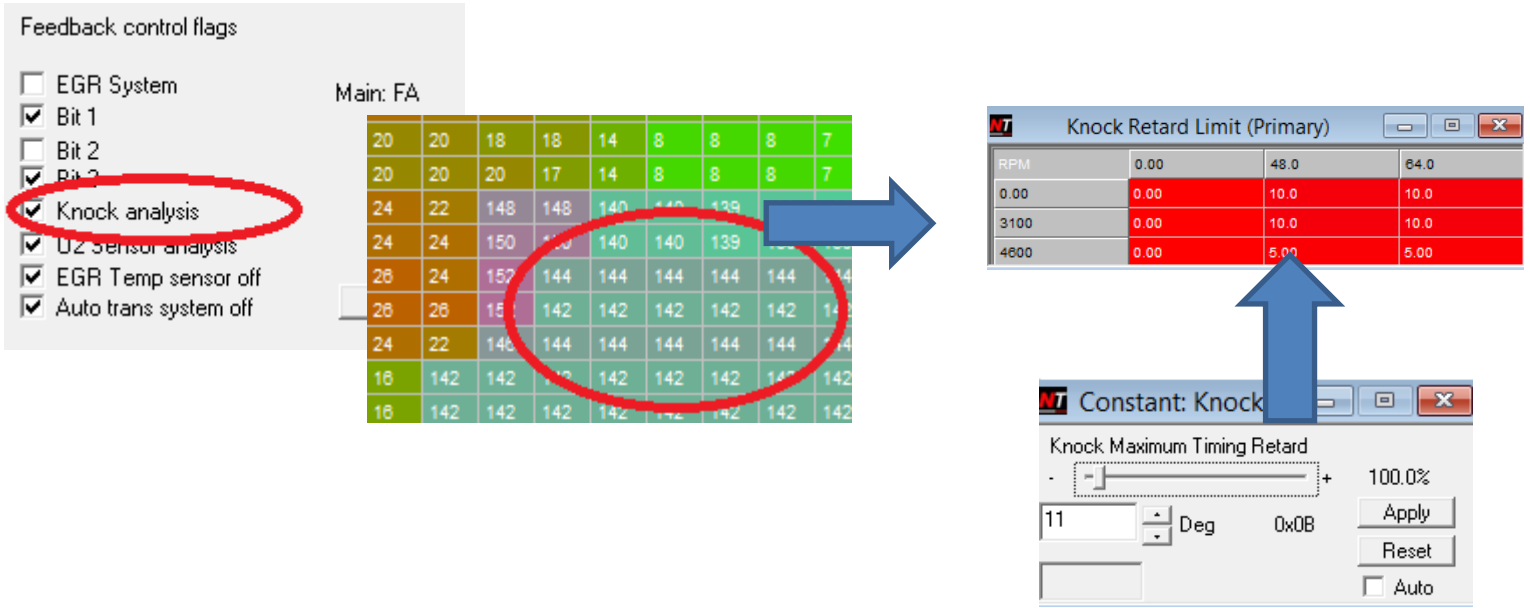
- Earlier model ECUs use analog knock circuit boards which use an onboard narrowband filter to monitor for knock
- Later model ECUs sample the knock sensor voltage and determine a noise level for each cylinder



- Once the limit has been exceeded the knock count increases

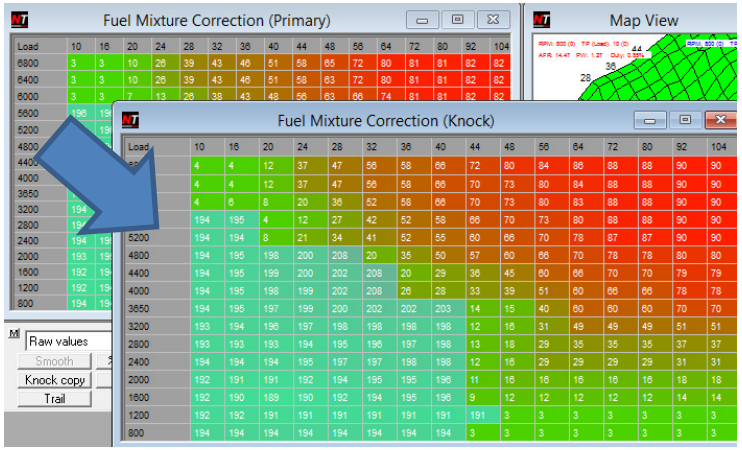
Knock Control Analysis

- 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

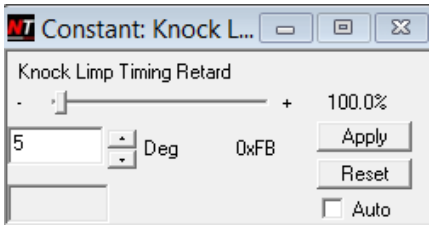


Knock Control Sensing

- 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

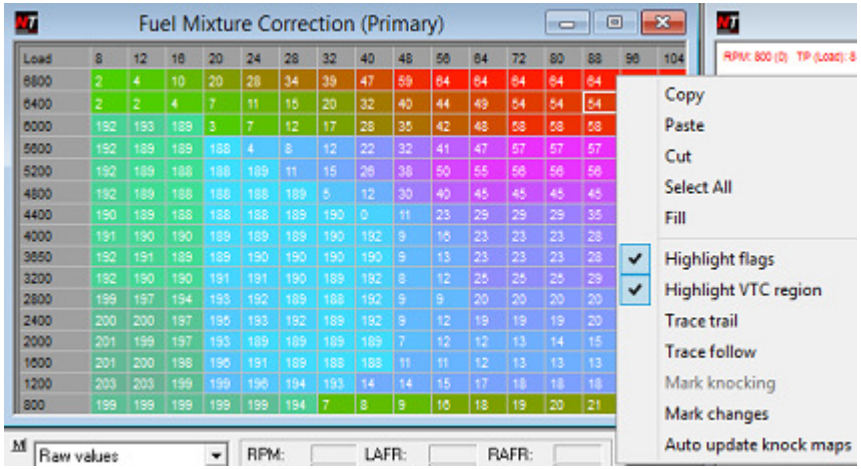


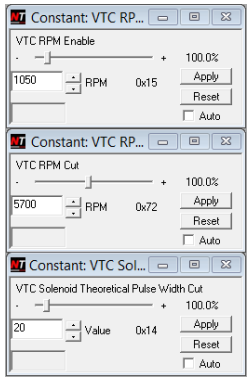
- When the knock sensor voltage is out of range then the ECU will retard ignition timing by the knock timing retard parameter



VCT Control

- 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
- Fuel map can have the VCT region highlighted to indicate the active area
- Consult ‘VCT solenoid’ indicator will illuminate when active. Consult Digital Control Register #2 must be enabled for the indicator to function.