RaceROM Custom Maps

Nissan R35 GTR

Nissan 370z

Subaru DIT

Subaru BRZ/Toyota GT86/Scion FR-S

V1.91

Index

Warning....4
Overview....5
Custom Map Overview....6
Custom Map functions defined....6
Speed Density implemented using RaceROM Custom Maps....7
The activation channel....8
Combining multiple maps on the same output channel....10
Two Dimensional (2D) maps....11
Using a custom map output as input to another custom map....12
Using one custom map output as activation channel for another custom map....13
The integral output functions....14
Driver Controlled Features....15
Auxiliary inputs....16
Debugging and Logging Features....17
Further Examples....17
Nissan GTR R35 Specific....18
Control Maps Overview....18
Enabling Custom Maps....19
Auxiliary inputs....20
Duty Cycle Output....21
GTR Custom Maps....22
Boost Control....22
Boost Control over 1.73bar....22
Boost Error over 1.73bar....22
Traction Control....22
Flex Fuel Sensor Import....22
Fail Safe Protection....23
AFR....23
Fuel Trims....25
Fuel Tank Level and Temp protection....27
Air and Coolant Temp protection....27
Exhaust Gas Temp Sensor Import (EGT) protection....28
Oil Pressure Fail Safe....29
Fuel Pressure (using a 3rd party sensor) Fail Safe....29
Fail Safe Summary....30
Coolant Temp Display Hijack (MFD)....31
Fuel Trim Short Term....31
AFR or Lambda....32
Ignition Timing....32
Engine Torque....33
Fuel Pressure (using a 3rd party sensor)....34
BRZ/GT86/FR-S Specific....37
Control Maps Overview....37
Enabling custom maps....38
Auxiliary inputs....39
Duty Cycle Output....43
BRZ Custom Maps....44
Boost Control....44
Flex Fuel Sensor Import....44
Traction Control....44
Wideband AFR Sensor Import....44

Closed Loop Fuel Control 45
Fail Safe Protection 46
AFR 46
Oil Temp 47
Air and Coolant Temp 47
Exhaust Gas Temp (EGT) 47
General Tuning Tips using Custom Maps 48
Ignition Tuning 48
Fuel Map Tuning 48
Potentiometer Input tuning 48
Dash Mounted Adjustable Control 49
Custom Maps Summary 49
Frequently Asked Questions 50
1. Custom Map activated 50
2. The engine will not start after programming 50
3. The check engine light comes on 50
4. Output conflict 51
5. Custom map activation delay 51

Warning

!!! CAUTION !!!

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

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

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

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

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

Retail customers

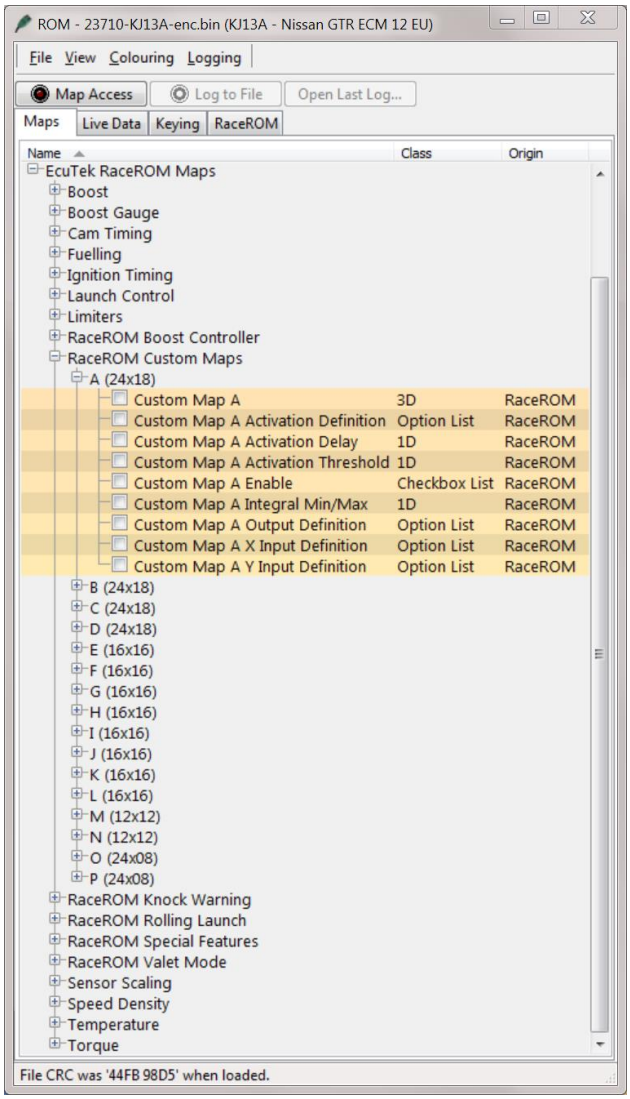
** If you have any doubt that you do NOT have the experienced required to use this product then you should NOT USE IT, you should simply contact your EcuTek Master Tuner shown clearly on the top of your Programming Kit or visit your preferred tuning shop to have a professional tuner to use it for you **

Overview

EcuTek **RaceROM Custom Maps** is an advanced feature for expert tuners only. It provides the tuner with the ability to modify the control algorithms within the ECU. The tuner can take advantage of this in order to develop their own features that few other tuners can provide. It can also be used to develop one-off fixes to overcome specific problems encountered while tuning a highly modified vehicle.

Custom Maps is currently available for the following vehicles:

- Nissan GTR
- Nissan 370z
- Subaru BRZ – Toyota GT86 – Scion FR-S
- Subaru DIT



Please note that the RaceROM Custom Maps are only available to trade customers, or retail customers that have purchased the optional RaceROM BRZ upgrade package from their Master Tuner.

Custom Map Overview

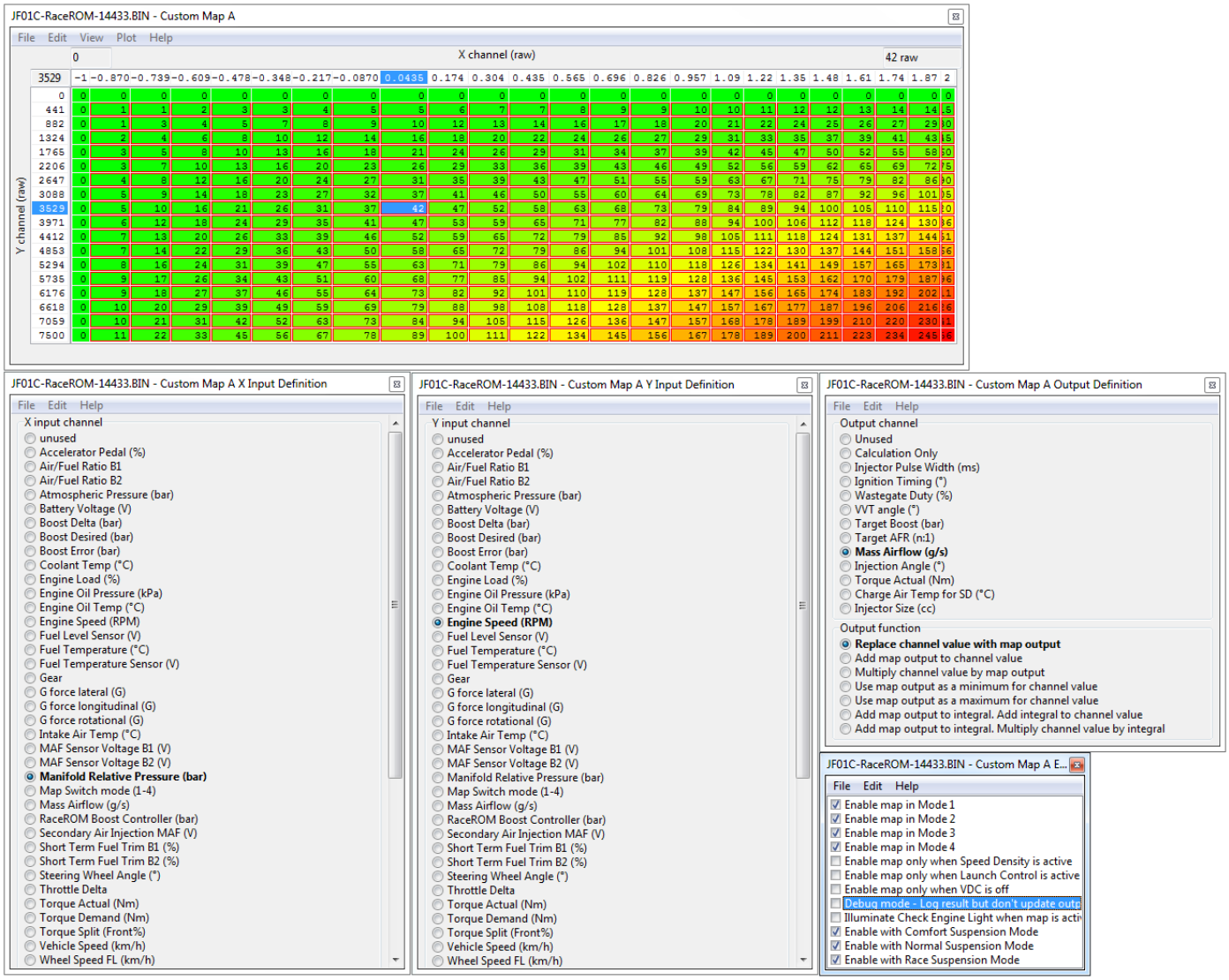
This section gives a brief description of the RaceROM Custom Maps for all supported vehicles. More detailed information is available later in this document related to specific vehicle models, in particular the Nissan R35 GTR and BRZ/GT86/FR-S.

Custom Map functions defined

EcuTek Custom Maps allows the tuner to create new maps within the vehicle ECU. For each new map, the tuner can specify the X and Y inputs, what the output of the map should be used for, and under what circumstances the map should be active.

For the purpose of illustration, the example below shows one method of implementing Speed Density using Custom Maps. In reality it would be better to use RaceROM's speed density feature for this.

Speed Density implemented using RaceROM Custom Maps

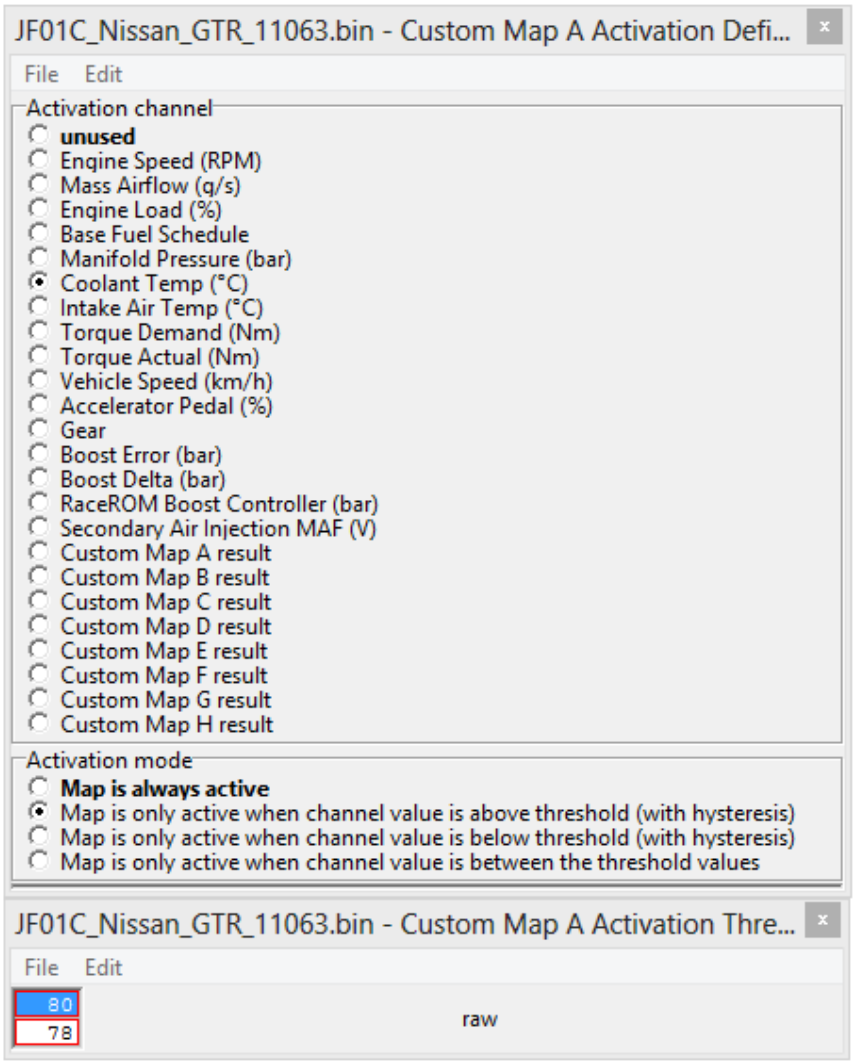


As you can see from the picture, we are using Custom Map A. The X input is defined as Manifold Pressure and the Y input as RPM. The output of the map is defined as Mass Airflow and the output function is set to replace the ECU's normal Mass Airflow with the output of our map. Finally, the custom map can be enabled in any of the 4 map switch modes.

The ECU will perform a map lookup, using RPM and Manifold Pressure inputs and then use the result as Mass Airflow instead of the value from the MAF sensor.

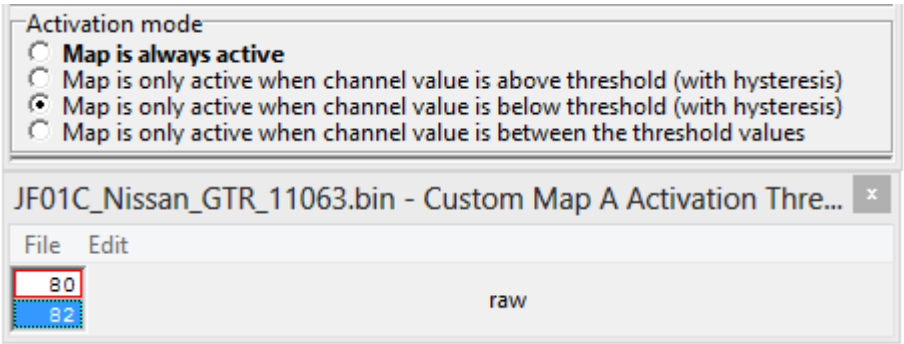
The input and output channels vary depending on the type of vehicle and are subject to change as we carry out development. A list of them can be found later in this manual.

The activation channel

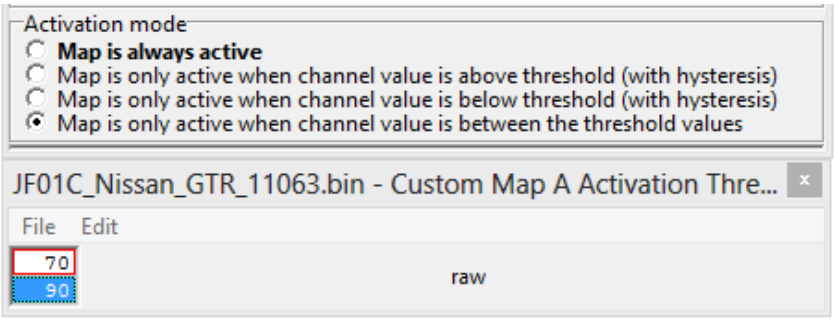


The activation channel is an On/Off switch for the map. Use it when you only want the Custom map to be active under certain conditions. In example 2, the map gets switched on when coolant temp rises above 80 degrees and then off when it falls below 78 degrees.

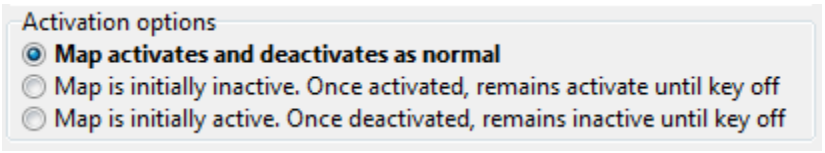
Example 2a
In example 2a, the Custom map is turned on when the channel value falls below 80 and it turns off then the value rises above 82.



Example 2b
In example 2b, the Custom map is turned on when the channel value is between 70 and 90.



Example 2c



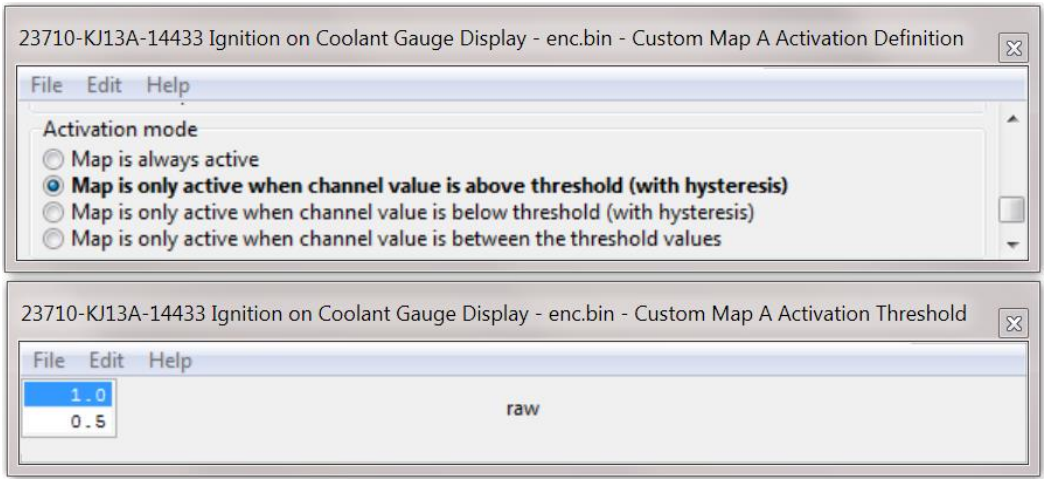
The activation options feature can be used to provide the following functionality:

Fail-safe map: Select the “Map is initially inactive” option and configure the map to activate in the error condition. Once triggered, the fail-safe map will remain active until the engine is stopped.

Start-up map: Select the “Map is initially active” option and then configure the map to deactivate when a certain condition is reached. Once deactivated, the map will not re-activate until the engine is stopped.

Example 2d

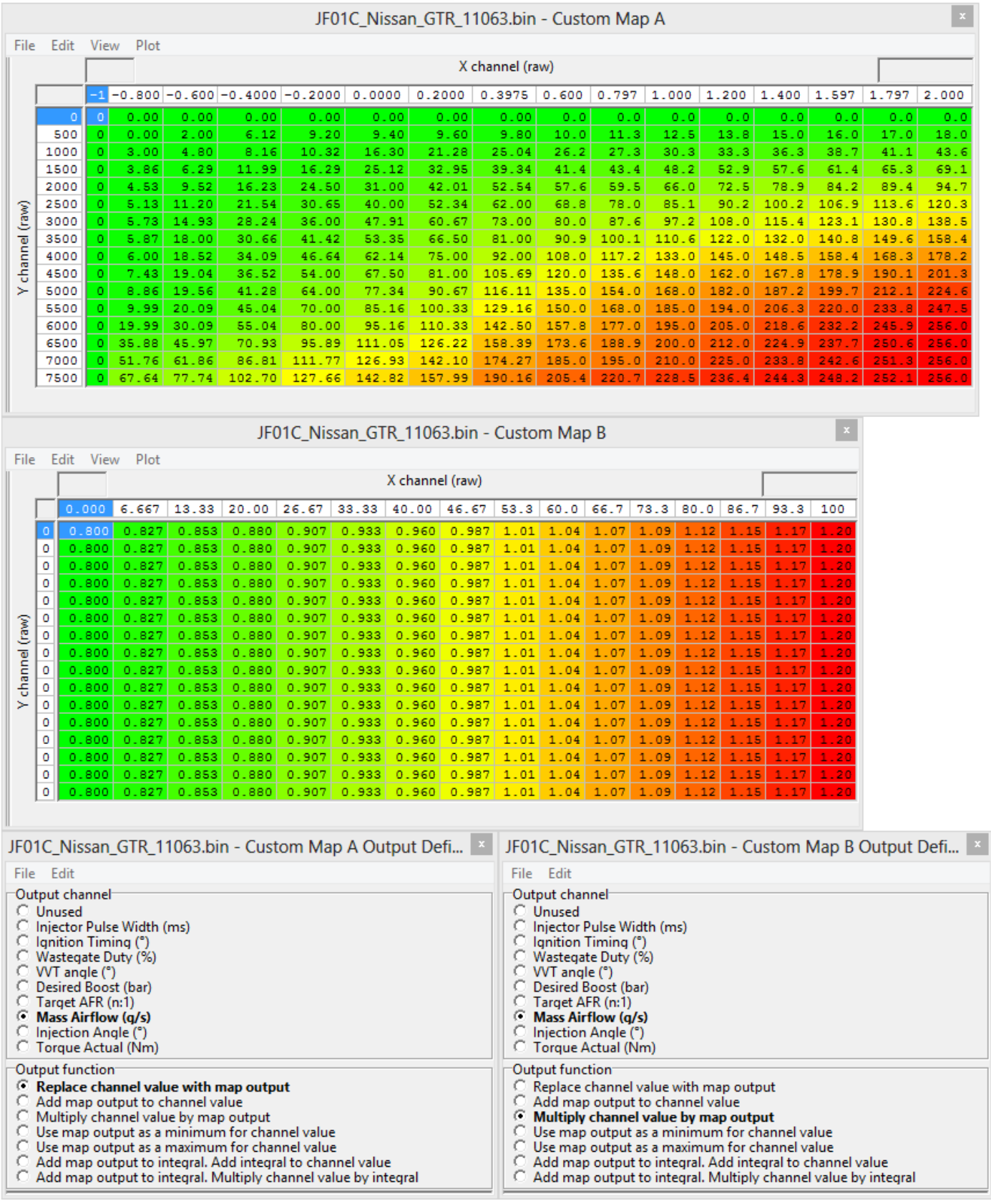
The activation options feature can be used against Gear, so a Custom Map can become active only whilst the car is in gear. In this instance we would configure the Activation Threshold as 1 to activate the map and 0.5 to deactivate the map, so when the Gear position is less than 1 then the map will deactivate.



Combining multiple maps on the same output channel

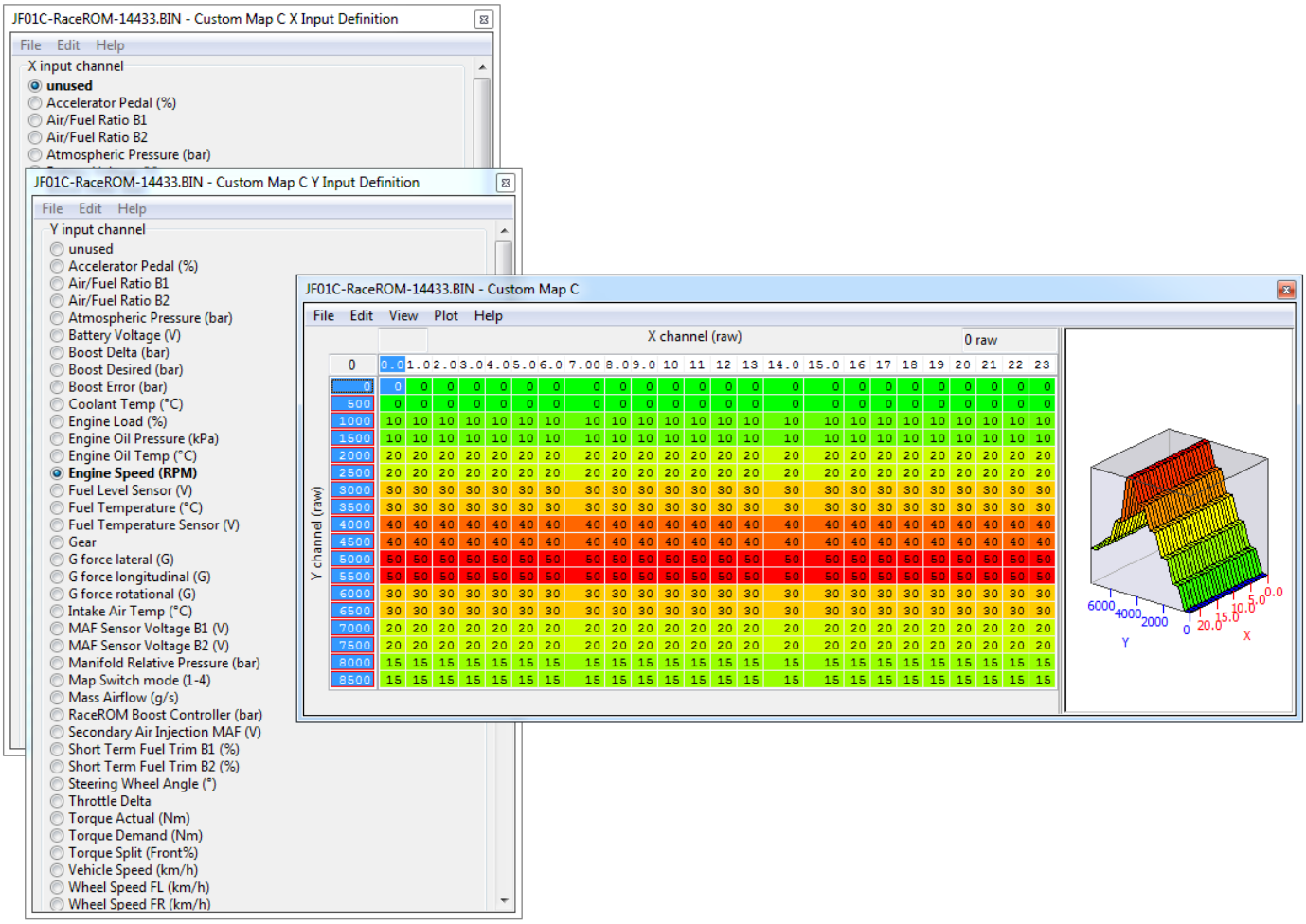
When several custom maps are configured to use the same output channel, they are applied in alphabetical order.

In this example, the ECU's Mass Airflow channel gets replaced by the output of Custom map A. This is then multiplied by the output of Custom Map B.



Two Dimensional (2D) maps

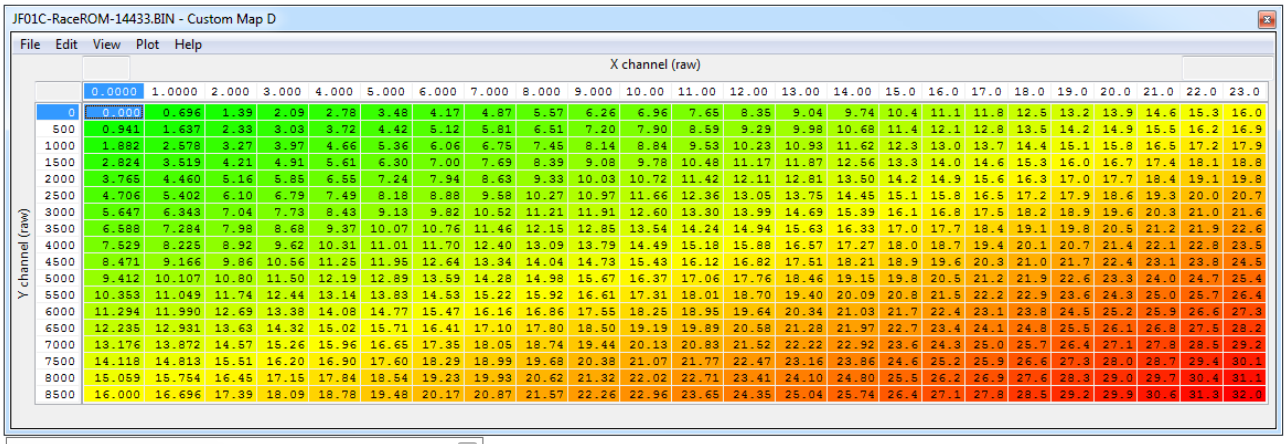
All Custom Maps are three dimensional (3D). However, if you structure the map carefully you can make a 3D map act as a 2D map.

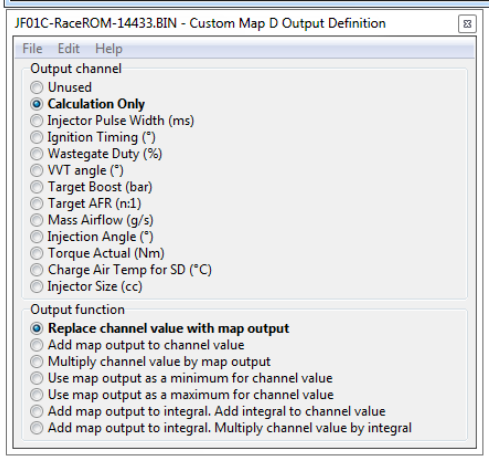


The X input channel is "unused", therefore the X input value will always be zero. Only the zero column on the map will be used, but it is very important to provide a complete X axis in ascending order. Otherwise the ECU's map lookup function may not work correctly. Always make sure to fully populate the maps and their axes with sensible values.

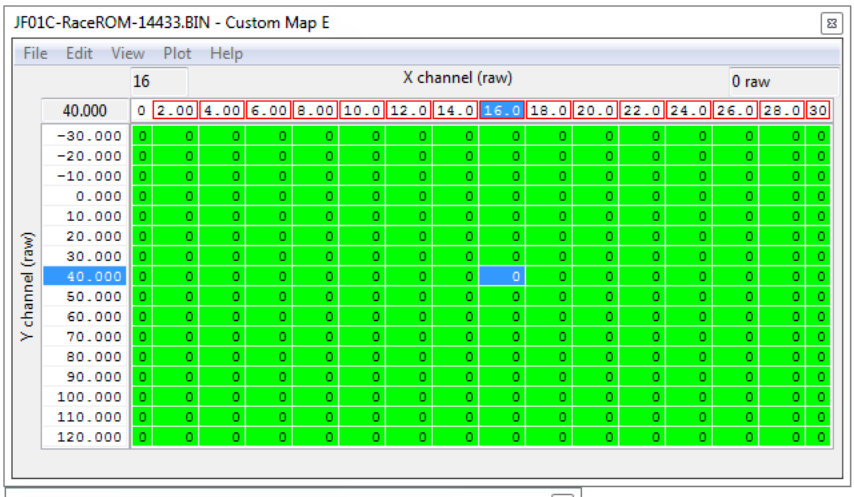
Using a custom map output as input to another custom map

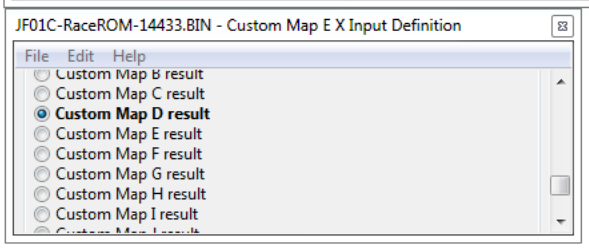
In this example, **Custom Map D** is configured for the “calculation only” channel. This means the result is calculated and stored for use in other maps.





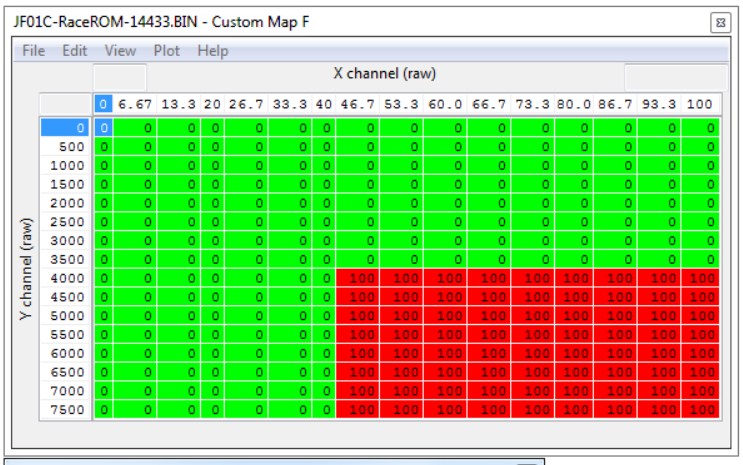
Custom Map E is configured to use the output of **Custom Map D** as its X input, as shown in the below screenshot:

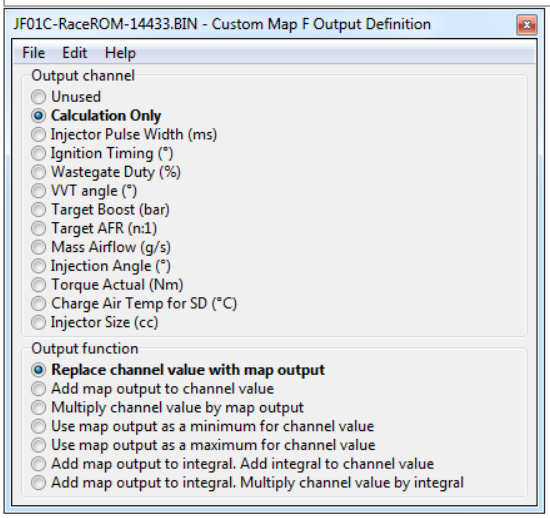


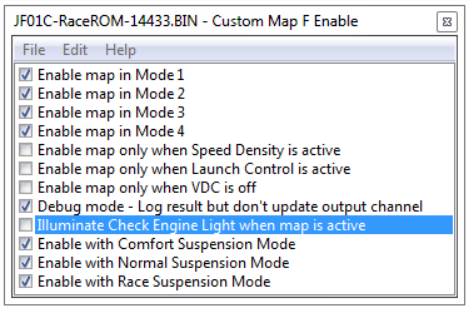


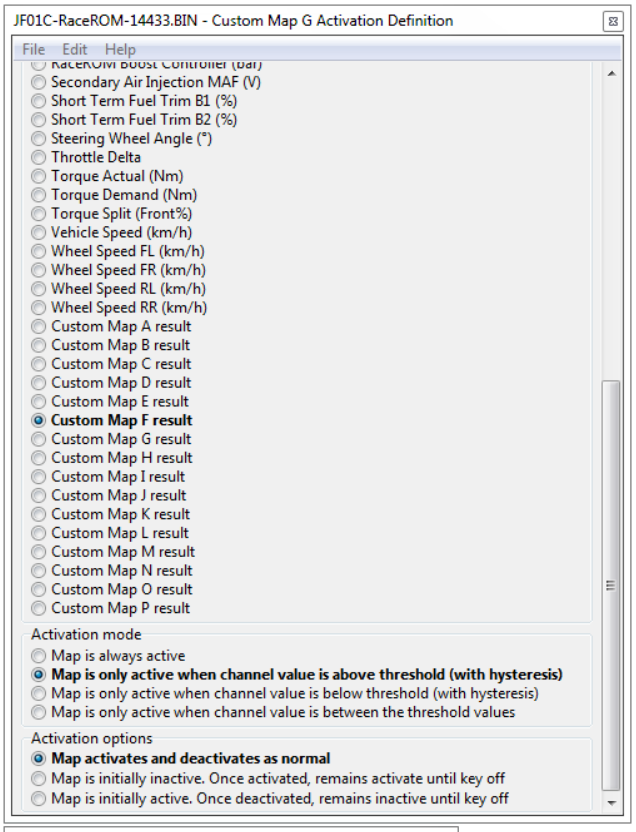
Using one custom map output as activation channel for another custom map

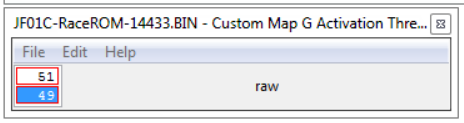
You can use the output of a Custom Map as the activation channel for another Custom Map. This allows you to activate the map on more than one criteria. In the below example, **Custom Map G** is configured to become active when **Custom Map F** is in the red zone.



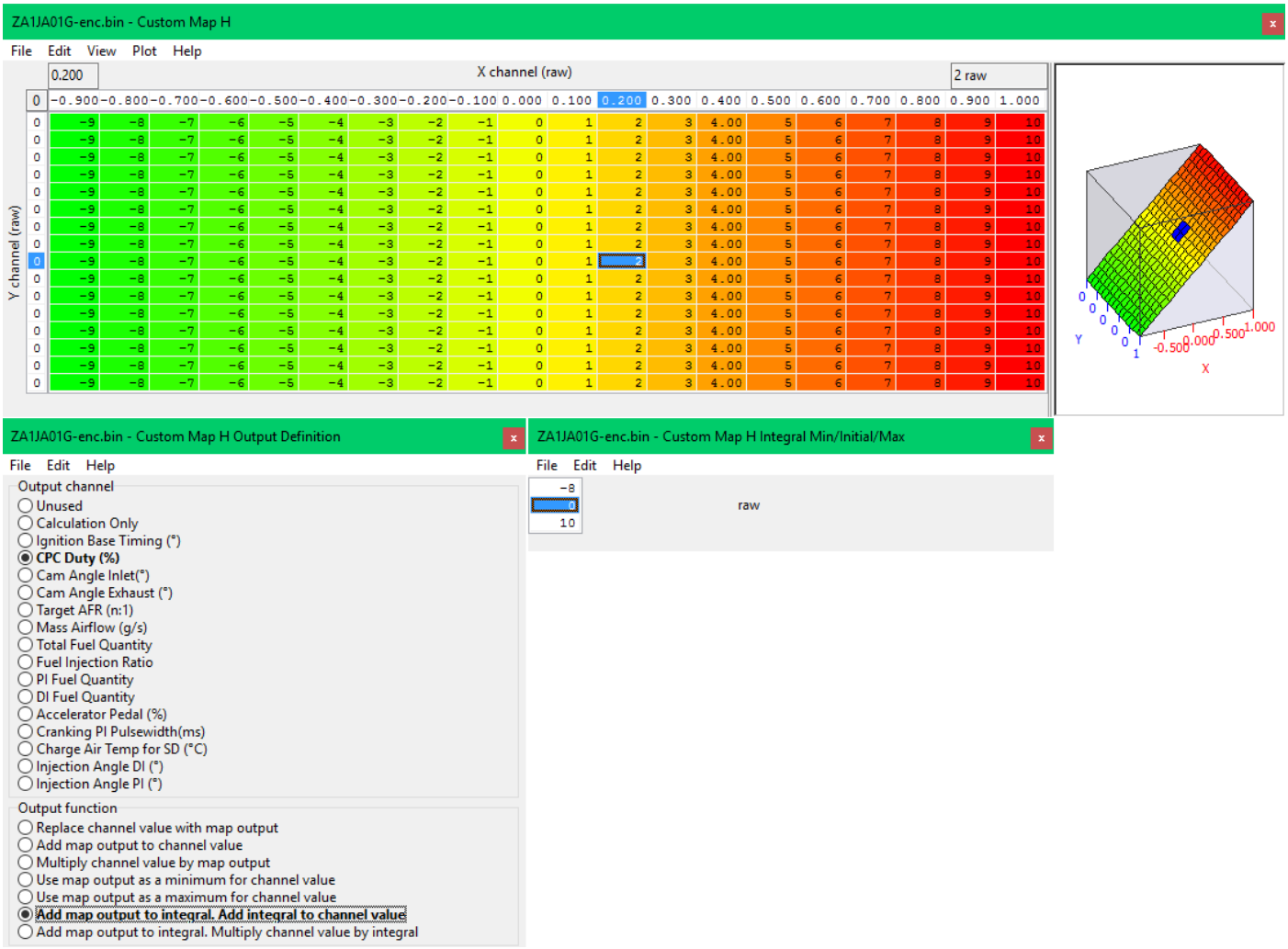








This feature allows you to create an integral that ramps up or down over a period of time. In the example below, the custom map is processed 100 times per second. This time frame update can vary depending on the vehicle and the selected output and is not adjustable but the values in the map can be increased or decreased to control the increment or decrement rate.



For the purpose of illustration, assume the map result is always 2. The first time the map is processed, the map result is 2, and this gets added to the integral 0 + 2 = 2. Then the integral gets added to the output channel (CPC Duty which is used for Wastegate Duty on BRZ). So the final calculation is (CPC Duty + 2).

One hundredth of a second later the map gets processed again, the result is 2 again, and this gets added to the integral. 2 + 2 = 4. Then the integral gets added to the output channel (CPC Duty). So the final calculation is (CPC Duty + 4) and so this continues.

The integral will start from the Initial value when the custom map becomes active, in the above example the Initial value is set to 0.
The Minimum allowed value is the top value and is set to -8 and the Maximum is the bottom value currently set to 10. The integral will gradually increase (or decrease depending on the X axis input) until the Minimum (-8) or Maximum (+10) allowed Integral value is reached.

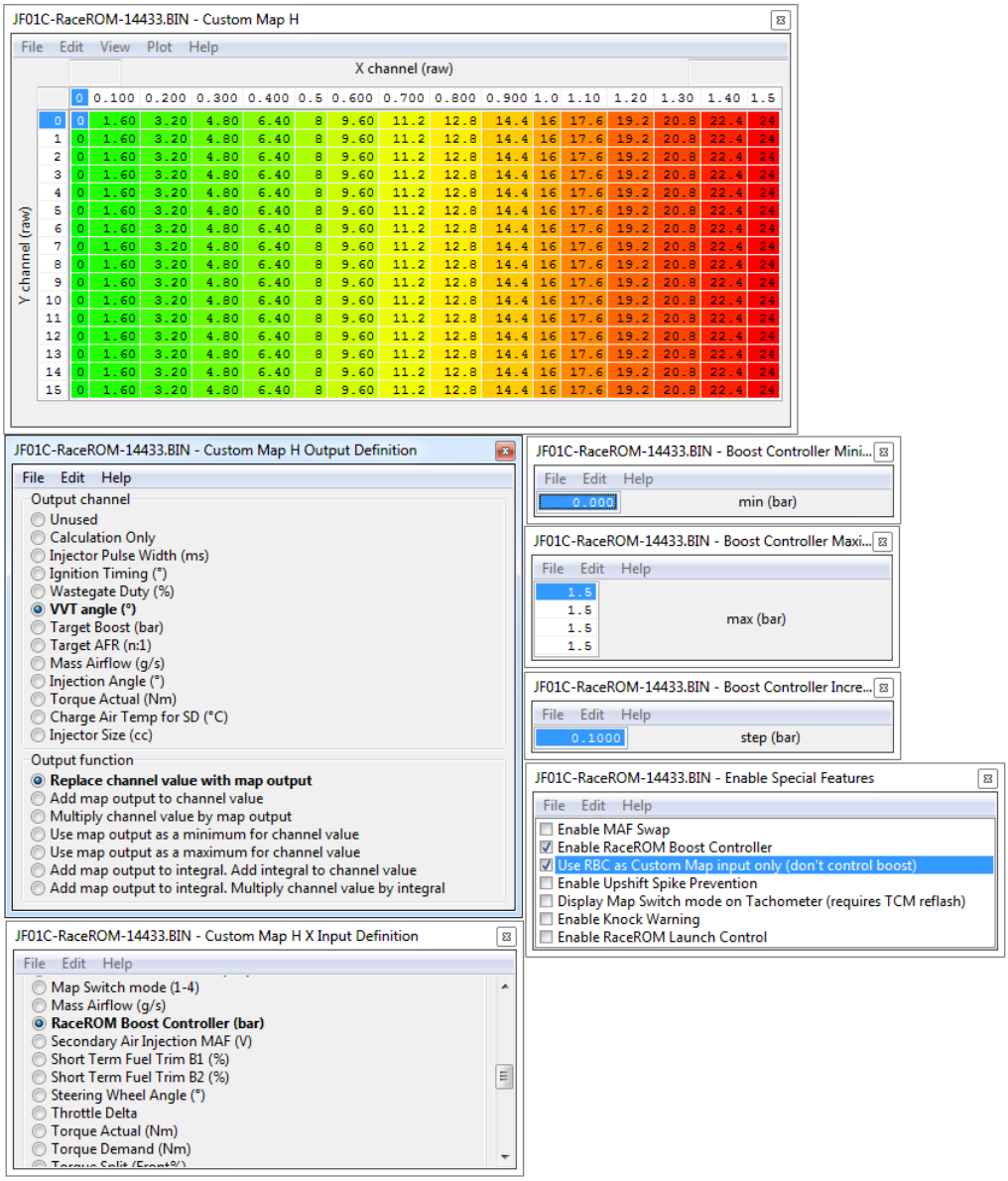
This can be used for accurate closed loop boost control or closed loop fuel control on full load on BRZ or Nissan 370z models.

Driver Controlled Features

In the example below, the Custom map is configured to take its X input from the RaceROM boost controller. The output of the Custom map is defined as (VVT) Intake Cam advance. The RaceROM boost controller is enabled configured with a range of 0 to 1.5 bar. The "Use RBC as custom map input only (don't control boost)" checkbox is set.

Using this configuration, the driver can adjust the VVT angle by pressing the cruise control button up and down.

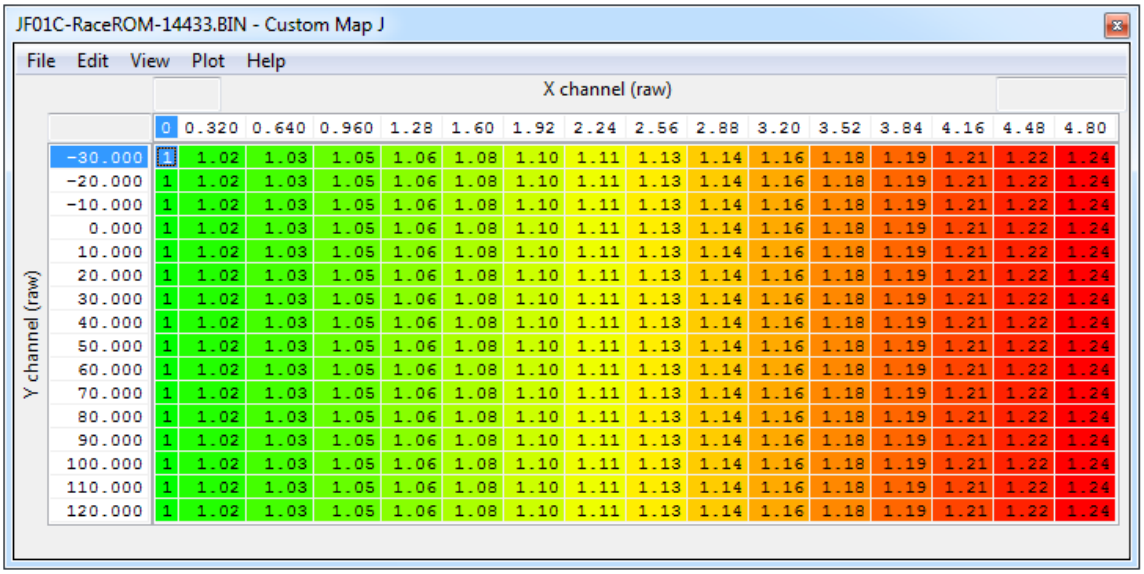
The driver-control option allows a certain amount of live tuning. You can adjust a particular parameter, for example: Injection Angle, while the car is running in order to find the optimum value. You can also use Ignition Timing, Mass Air Flow or Wastegate duty so you can see the change live.



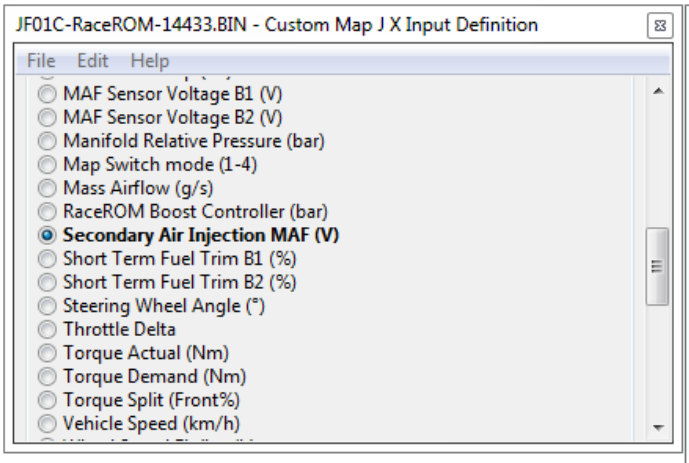
This can be used on Nissan GTR and Nissan 370z.
You can also create an adjustable input on Subaru BRZ and DIT models by importing a 0-5v input through the CPC pressure sensor or Rear 02 sensor (for example) and by using a potentiometer you can achieve the same results.

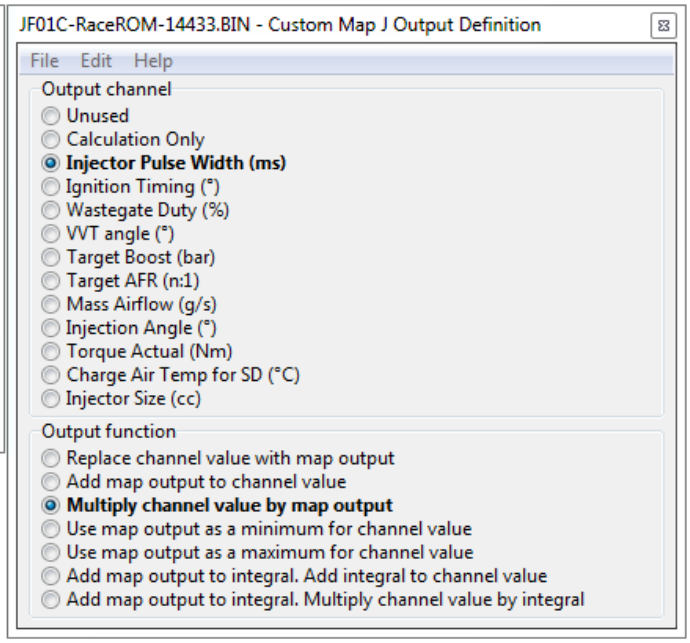
Auxiliary inputs

The “Secondary Air Injection MAF voltage” is provided as an input to the custom maps. This measures a signal between 0 and 5 volts on pin 24 of the ECU. If you remove the secondary air injection system, you can utilise this input for your own sensor such as charge air temperature or fuel ethanol content.
If you remove the secondary air injection system, we recommend you fill the “Secondary Air Injection MAF Scale” map with zeroes.
You can also enable Speed Density full time and use the MAF Bank #1 and MAF Bank #2 as addition 0 – 5volt inputs, this offers a further two inputs into the ECM.



Y channel (raw)	0	0.320	0.640	0.960	1.28	1.60	1.92	2.24	2.56	2.88	3.20	3.52	3.84	4.16	4.48	4.80
-30.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
-20.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
-10.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
0.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
10.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
20.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
30.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
40.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
50.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
60.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
70.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
80.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
90.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
100.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
110.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24
120.000	1	1.02	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.22	1.24





Debugging and Logging Features

As previously mentioned, each map has a debug mode. This means that the map will be processed when the ECU is calculating the map's output channel, but the result is not used as part of the calculation. This can be used in conjunction with the logging features to test the effect that a custom map would have, but without affecting the operation of the engine.

Each custom map has two logged parameters: interim and result. The values that get logged here depend on the selected output function:

Output Function	Interim Parameter	Result Parameter
Unused	0	0
Replace channel value with map output	old channel value	map output
Add map output to channel value	map output	channel value +(plus) map output
Multiply channel value by map output	map output	channel value * (multiply) map output
Use map output as a minimum for channel value	map output	the greater of channel value and map output
Use map output as a maximum for channel value	map output	the lesser of channel value and map output
Add map output to integral. Add integral to channel value	integral	channel value + integral
Add map output to integral. Multiply channel value by integral.	integral	channel value * integral

Further Examples

EcuTek have a number of example ROM files that demonstrate how you can use custom maps to create advanced features such as:

- Custom boost control for GTR and BRZ/FR-S inc. proportional and integral compensation.
- Wideband sensor import to see true AFR on BRZ/FR-S models.
- Ethanol sensor import allowing true Flex Fuel tuning.
- Traction Control using a torque reduction to control wheel slip amount.

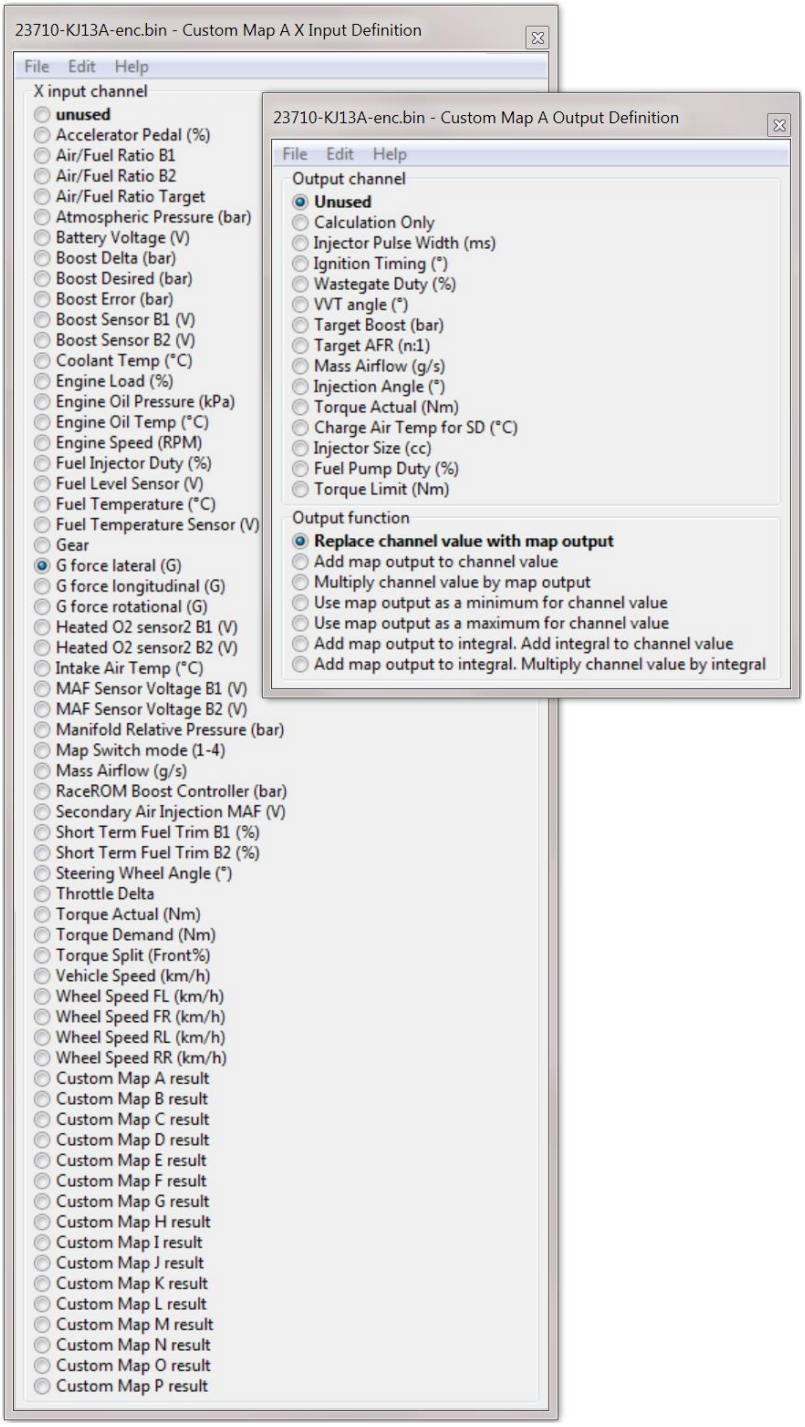
These examples are defined in detail in the relevant BRZ and GTR Tuning manuals.

There are additional features that can also be used like Fail Safe protections and Custom Gauge hijacking, these are defined in this dedicated Custom Maps manual over the next few sections.

Nissan GTR R35 Specific

Control Maps Overview

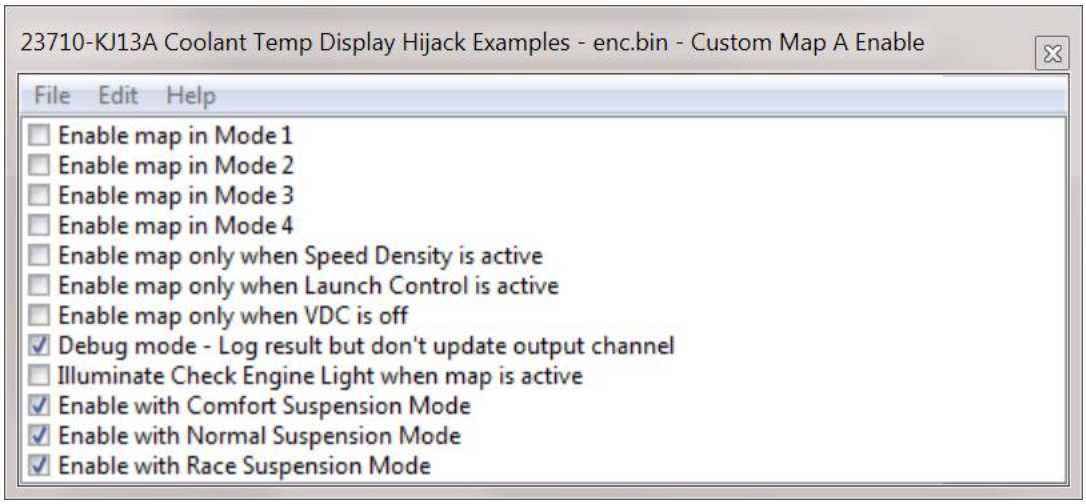
The Input and Output Channels for Nissan GTR are shown below.



NOTE: The Input Channels for Engine Oil Pressure, Steering Angle and G sensor are only available when used in conjunction with RaceROM Phase 4 TCM or newer

Enabling Custom Maps

Each custom map has its own enable map. You must select which modes you would like the map to be enabled in. You can also specify that the map is only active when the car is running in RaceROM Speed Density mode, or when the Nissan Launch Control system is active Input and Output Channel Shown.



When used in conjunction with our Phase 4 TCM upgrade or newer, custom maps can be enabled depending on the position of the suspension mode switch. You must have at least **one** of the suspension mode checkboxes selected in order for the map to be active. By default, maps are active in all three modes.
If you disable all the Suspension Mode check boxes then the Custom Map will **not** work.

Auxiliary inputs

We have 7 different inputs for Nissan GTR. These are:

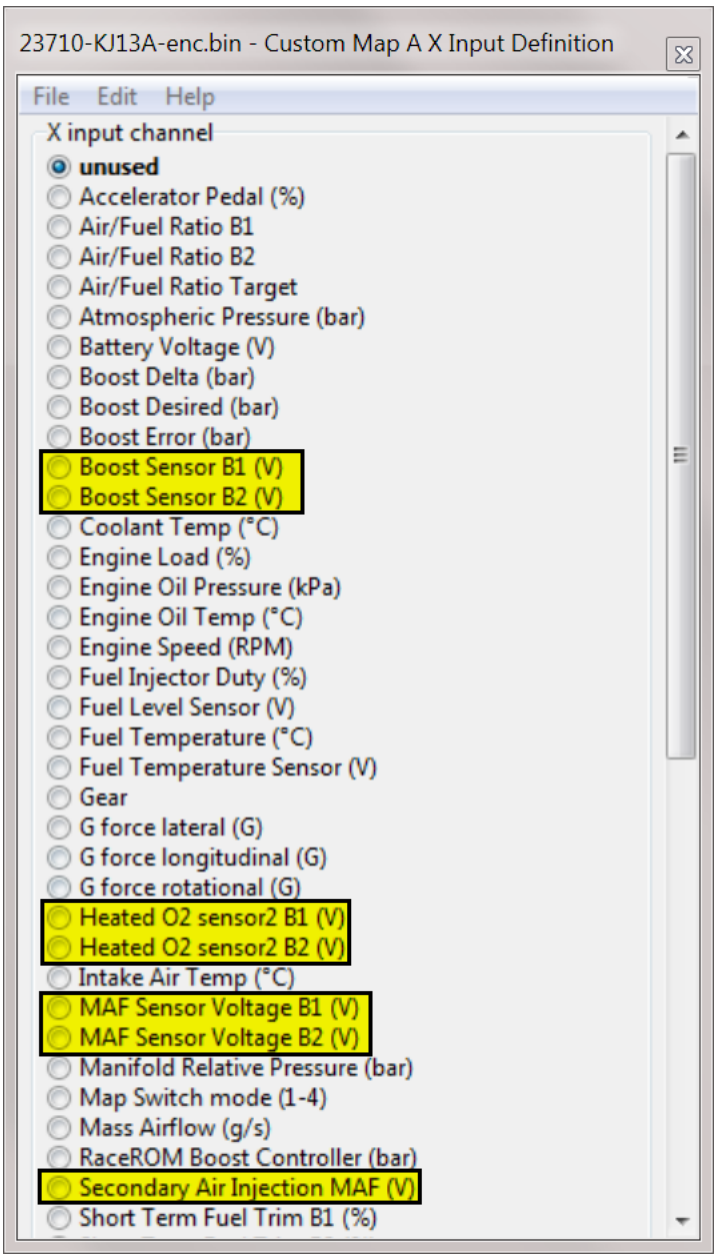
- Boost Sensor B1
- Boost Sensor B2
- Rear O2 Sensor B1
- Rear O2 Sensor B1
- MAF Sensor B1
- MAF Sensor B2
- Secondary Air Injection MAF

All inputs are 0 – 5 volts, they cannot be a PWM frequency input.

All of these Inputs can be logged in Live Data and the results of the Custom Maps can be logged as Custom Map Interim and Custom Map Result for each map.

When repurposing the Boost sensor Inputs then Custom Map Boost Control must be used for Boost Control and Boost Limit.

When repurposing the MAF sensor Inputs then SD must be enabled and the Intake Air Sensor should be moved to the Charge Air Pipe using a 'Got Boost Performance' Speed Density kit.



Duty Cycle Output

Coming soon.

GTR Custom Maps

There are many uses for Custom Maps on the Nissan GTR, as previously mentioned some of these are defined in the dedicated GTR Tuning Guide, please see the relevant section for more information.

Boost Control

See the ‘How to setup Custom Maps Boost Control’ section of the GTR Tuning Guide.

Boost Control over 1.73bar

See the ‘How to setup Boost Control over 1.73bar’ section of the GTR Tuning Guide.

Boost Error over 1.73bar

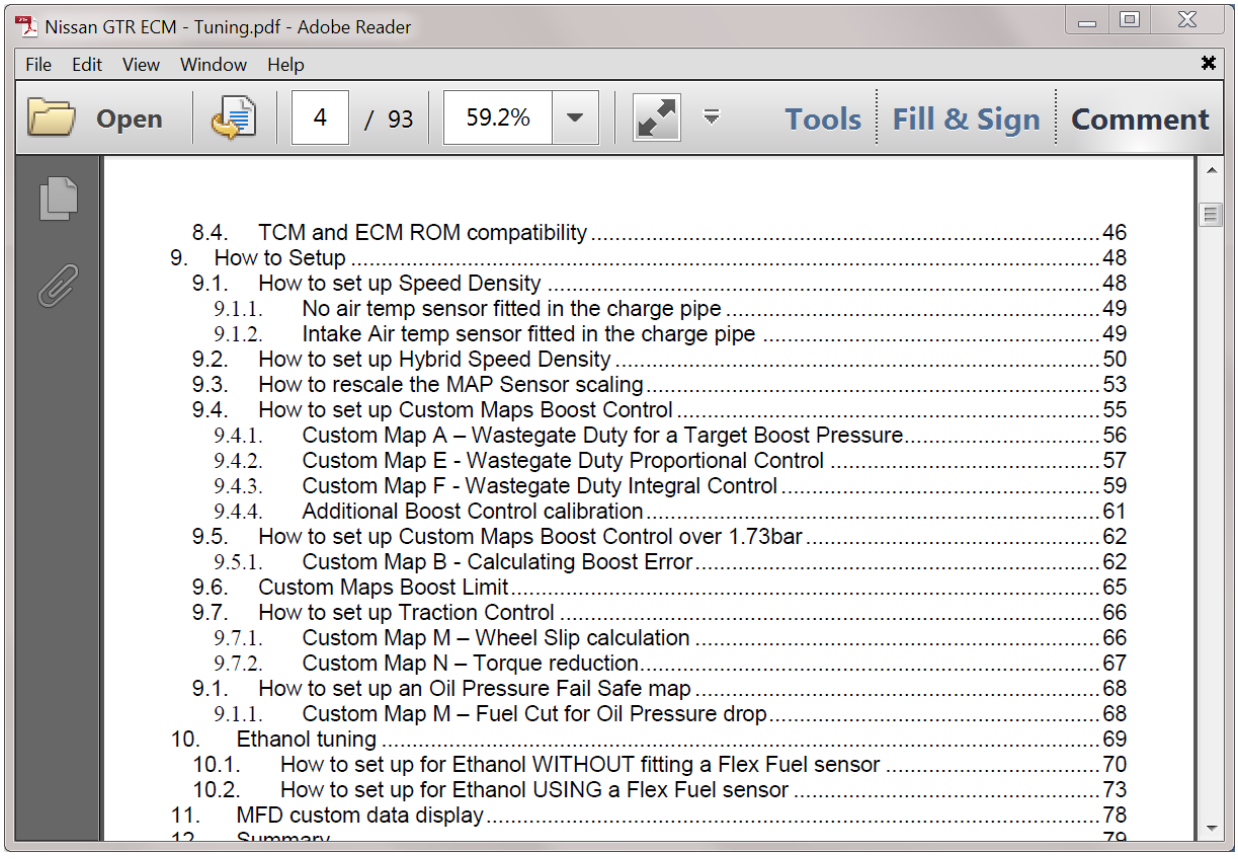
See the ‘How to calculate Boost Error’ section of the GTR Tuning Guide.

Traction Control

See the ‘How to setup Traction Control’ section of the GTR Tuning Guide.

Flex Fuel Sensor Import

See the ‘How to setup for Ethanol and import Flex Fuel sensor’ section of the GTR Tuning Guide.

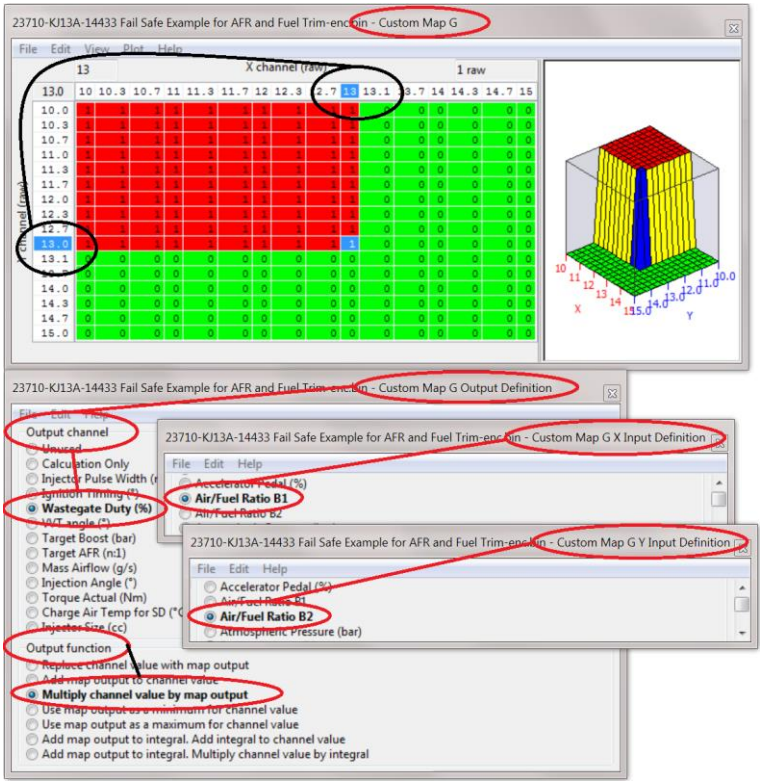


Other GTR specific Custom Map functions like Fail Safe and Coolant Temp Gauge Hijack are listed below.

Fail Safe Protection

AFR

As the Nissan GTR has wideband lambda sensors we can use Custom Maps to protect the engine on full load by watching the AFR on full power. If the AFR becomes too lean then the boost pressure can be reduced to protect the engine.



Custom Map G – AFR Fail Safe

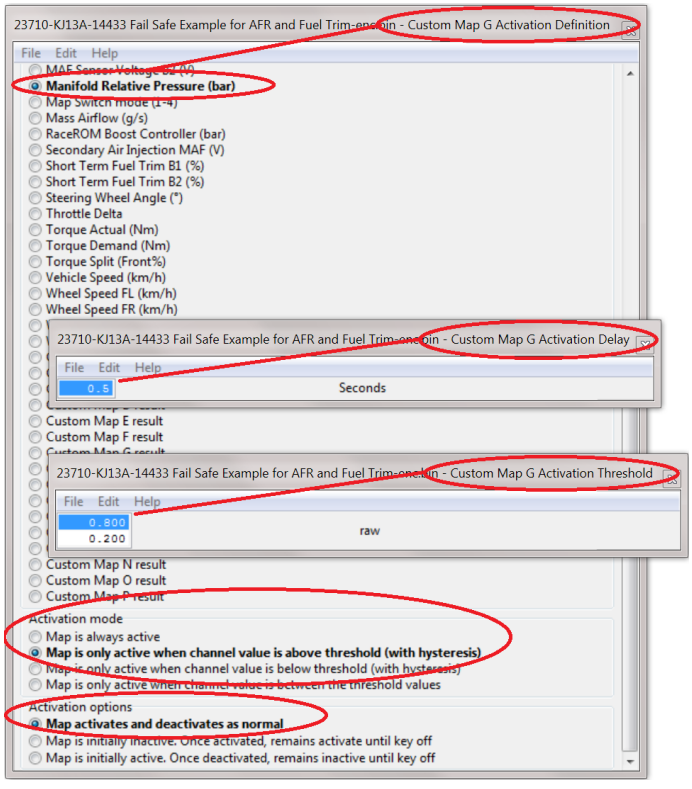
- X axis is AFR Bank #1
- Y axis is AFR Bank #2
- Output channel will be multiplied by the value in Custom Map G.

So in this instance the Wastegate Duty would be multiplied by the output of Custom Map G (multiplied by 1 as shown on the example on the left).

If the AFR (either Bank #1 or #2) is richer than 13:1 AFR then the WG Duty will be multiplied by 1 and the WG Duty will not change.

If the AFR is leaner than 13:1 AFR then the WG Duty will be multiplied by 0 and the Boost Pressure will be reduced.

NOTE: It's important to notice the two black circles on the X and Y axis shown to the left, you will see the values step between **13** and **13.1 AFR** so there is very little interpolation and a defined step between WG Duty working or NOT working.

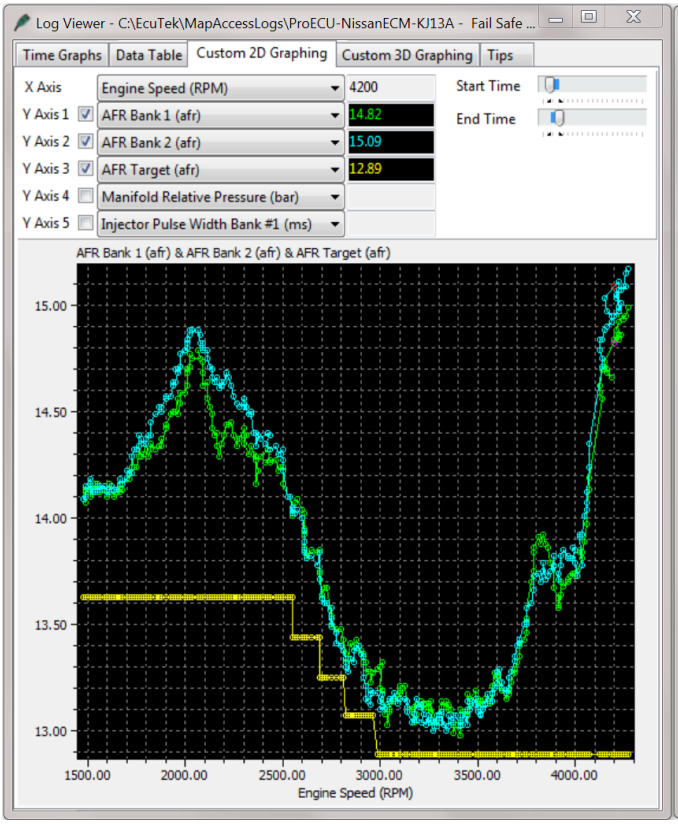


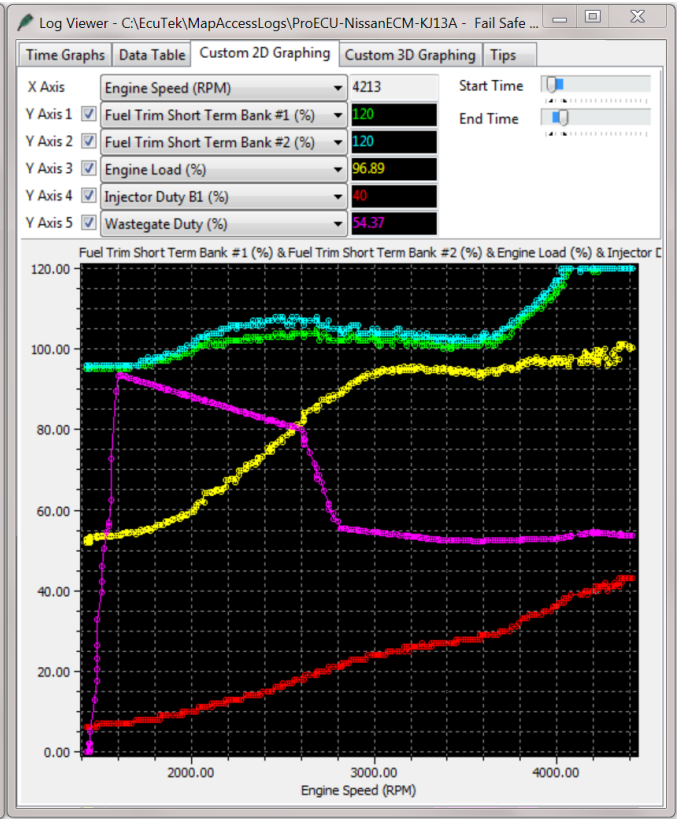
We should also set up a load based activation threshold for this fail safe to be allowed to work.

You can see that the Custom Map G Activation definition is Manifold Relative Pressure (MRP) and the Activation Threshold is set to 0.8bar boost with a further timer delay of 0.5 seconds before it's allowed to work. The reactivation Manifold Relative Pressure threshold is set much lower at 0.2bar so the boost pressure will have to drop significantly before the WG Duty is restored (Custom Map G is disabled).

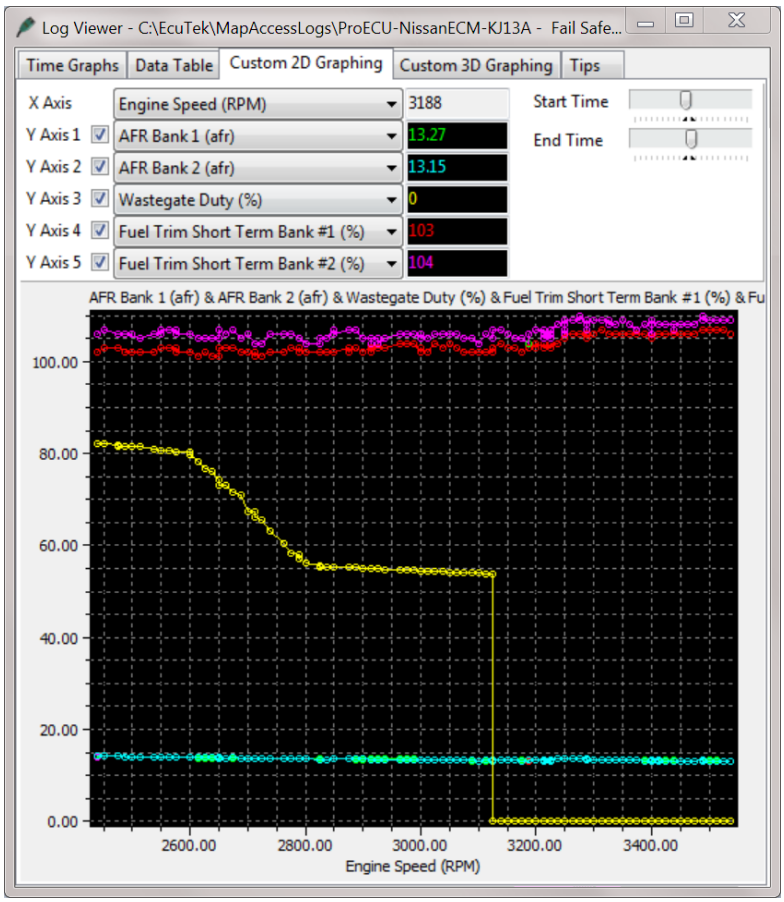
So the WG Duty will only be reduced if the AFR is leaner than 13:1 and over 0.8 bar boost for more than 0.5 seconds. You will also see the MRP needs to drop below 0.2bar before the fail safe map will be disabled and the WG Duty will be allowed to work again.

The log file below shows where the 2nd fuel pump has failed and there are no Fail Safe maps enabled. These are two screen shots from the same log file.





The left hand side shows the AFR becomes lean at higher RPM due to lack of fuel delivery. The right hand side shows the FTST climbing to 120% trying to add more fuel but the AFR is climbing out of control and is dangerously lean at 15:1. The engine will be seriously damaged!



Now see the same 2nd fuel pump failure event again when the Fail Safe Custom Map G has been enabled.

You can see as soon as the AFR becomes leaner than 13:1 the WG Duty is reduced to zero and the boost pressure reduces saving the engine.

The Fail Safe map is monitoring the AFR on BOTH bank #1 and bank #2, so even if one bank goes lean then the fail safe map will be tripped and the boost reduced.

Fuel Trims

The Nissan GTR uses closed loop fuel trims, Fuel Trim Short Term (FTST) and Fuel Trim Long Term (FTLT). These FT's will adjust the Injector open time (ms) to achieve the Target AFR from the fuel map.

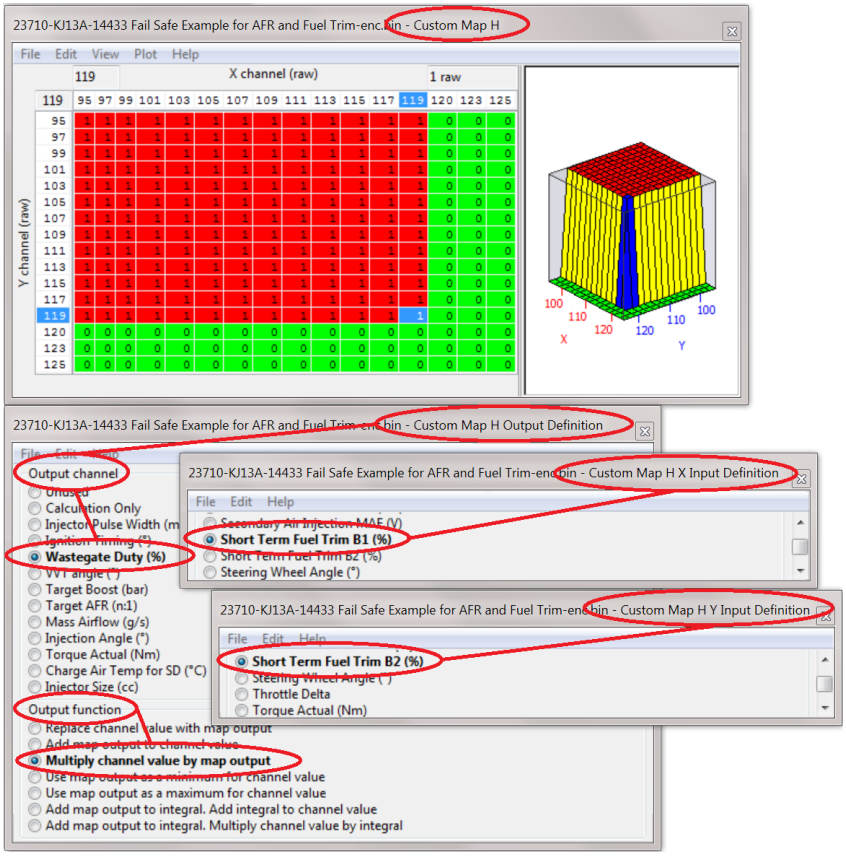
We should adjust the MAF Sensor scaling or SD-VE map (if running on SD) to keep the FT between 95 to 105% at all times, see the GTR Tuning Guide for more details on using the MAF scaling or SD map to dial in the FT's and the **importance of getting them tight**.

Once the FT's are dialled in around 100% mark then we don't expect to have to pay attention to them again but there are various influencing factors that can cause the FT to change, these can be Air Temp, Altitude, Fuel Temp, Injector issues and more importantly Fuel Pump failures which can cause engine failure in seconds.

We can use Custom Maps to protect the engine on full load by watching the FT's on full power. If the STFT suddenly becomes too high (maybe over 120%) then the boost pressure can be reduced to protect the engine before the AFR even starts to become lean.

<u>Custom Map H – Fuel Trim</u>

- X axis is Fuel Trim Short Term B1
- Y axis is Fuel Trim Short Term B2
- Will multiply the output channel.

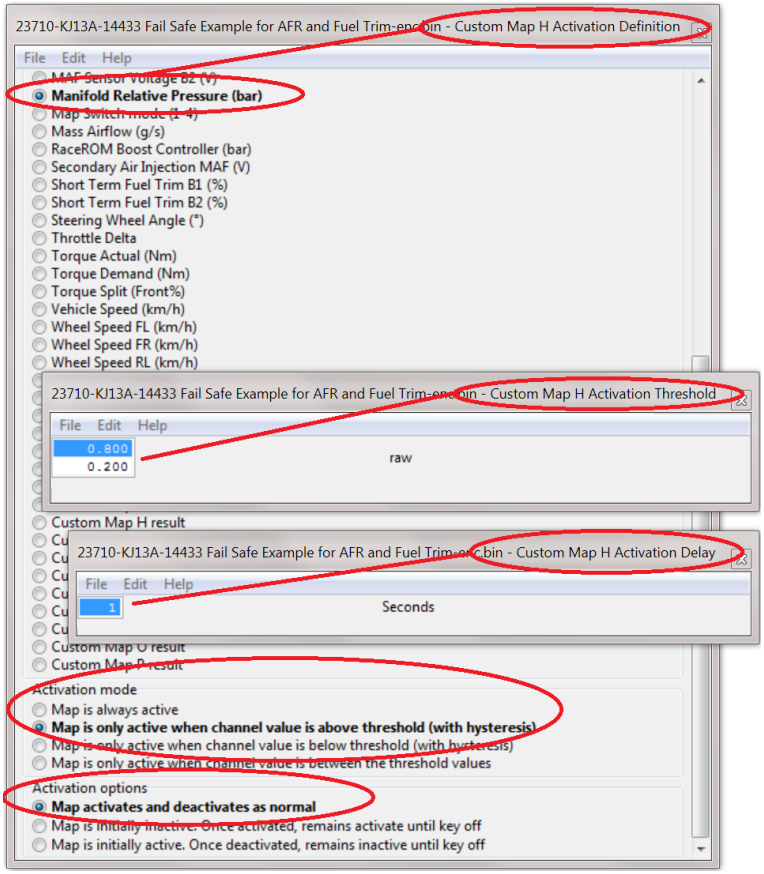


Custom Map H will multiply the current Wastegate Duty by the values in Custom Map H.

If the FTST (either Bank #1 or #2) is below 120% then the WG Duty will be multiplied by 1 and the WG Duty (and boost pressure) will not change.

If the FTST is 120% or greater the WG Duty will be multiplied by 0 and the boost pressure will be reduced protecting the engine.

NOTE: It's important to notice the X and Y axis where there is a defined step between 119% and 120% so the WG Duty is either ON or OFF.



We should also set up a load based activation threshold for this fail safe to be allowed to work.

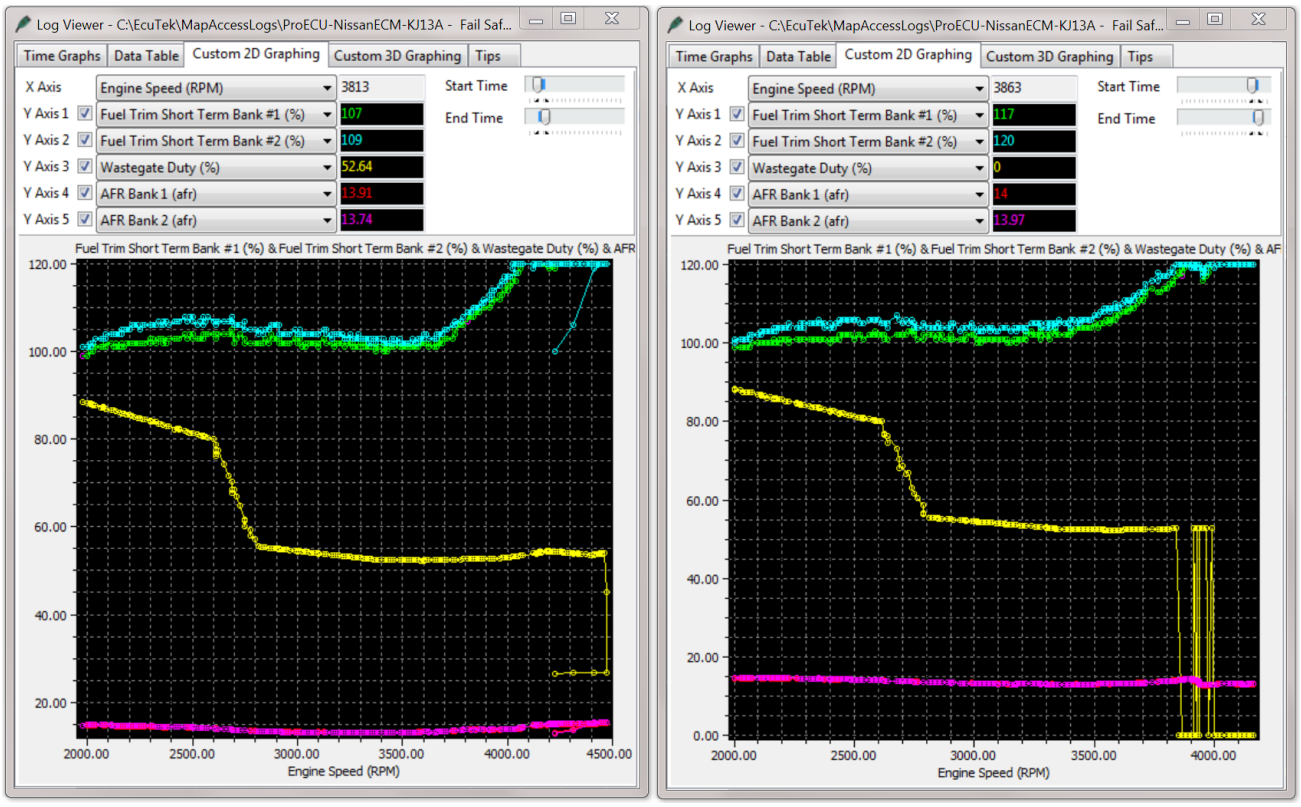
You can see below that the Custom Map H Activation definition is Manifold Relative Pressure (MRP) and the Activation Threshold is set to 0.8bar boost with a further timer delay of 1 second, note that the map 'deactivation' threshold is set much lower than the 'activation' at 0.2bar so boost has to reduce significantly before the WG Duty is allowed to increase again.

So the WG Duty will only be reduced if the FTST is greater than 119% and over 0.8bar for more than 1 second.

You can see below as the FTST rises to maintain the Target AFR when it crosses the 120% FT threshold that 1 second later the WG Duty is reduced to zero.

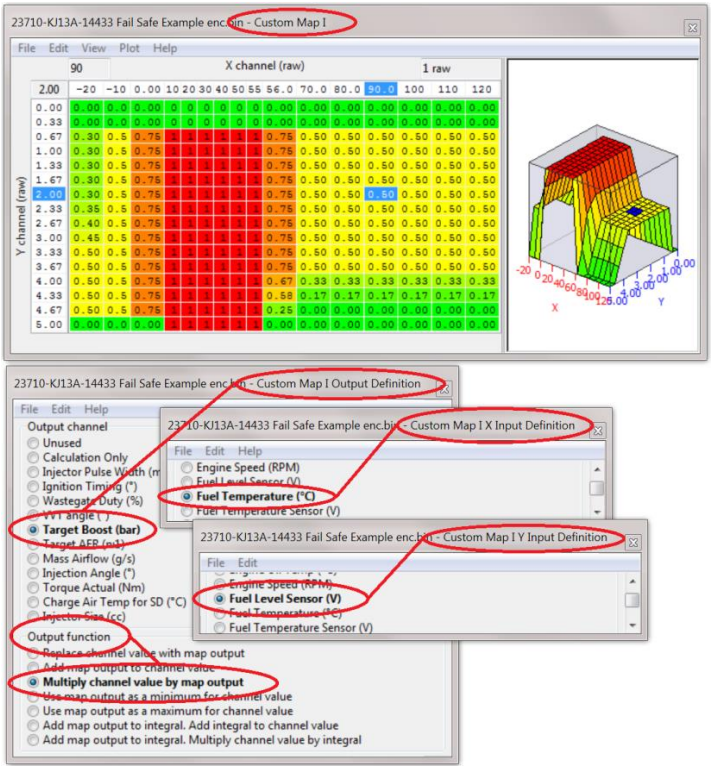
With the various known fuel pump issues on the GTR the Fuel Trim fail safe should be added to each GTR tune. The log file below shows where the 2nd fuel pump has failed; these are two screen shots from the same log file.

The left hand side shows the FT climbs to 120% past 3500rpm due to lack of fuel delivery.
The right hand side shows the same event again when the Fail Safe Custom Map H has been enabled. You can see as soon as the FT becomes greater than 120% the WG Duty is reduced to zero and the boost pressure reduces protecting the engine.



Fuel Tank Level and Temp protection

This custom map can be very useful for track day usage where Fuel Temperatures can climb and cause Fuel Trim deviations. The Fuel Tank Level can also be monitored and power reduced as the risk of fuel surge or fuel starvation increases.



Custom Map I – Fuel Protection Safety

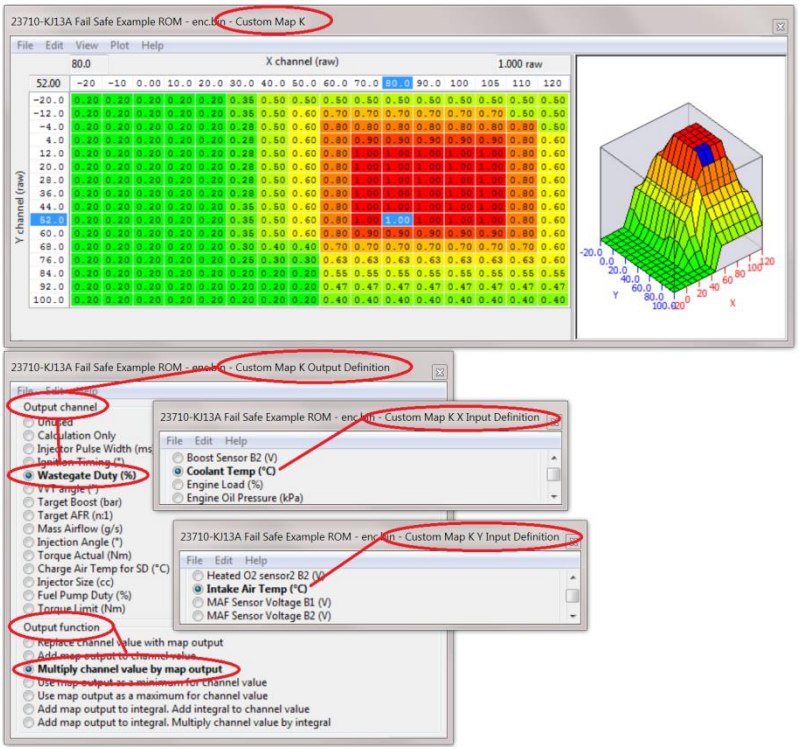
- X axis is Fuel Tank Temperature
- Y axis is Fuel Tank Level Sensor
- The map values will multiply the current WG Duty when the fuel conditions are out of range.

We can reduce the power output when the fuel level is low or there is a risk of fuel surge or fuel starvation. We can also reduce power output when the fuel tank temp is too cold or gets too hot (like during sustained levels of track action). Activation can be set against Coolant temp say over 80deg C for example.

The custom map will reduce the boost pressure to alert the driver that it's time to refill the tank or that the temps are simply getting too high and there could be the risk of engine damage.

Air and Coolant Temp protection

We can create a custom map to reduce power output for a given Air and Coolant Temp, this provide additional engine torque output control during warm up or excessive temperatures (like track use or heat soak).



Custom Map K – Air and Coolant Temp protection

- X axis is Coolant Temp
- Y axis is Intake Air Temp
- The map values will multiply the WG Duty is out of range.

This is a very simple map that can work in conjunction with the various factory torque reduction settings.
Alternate axis could be Oil Temp or Atmospheric Pressure.

Exhaust Gas Temp Sensor Import (EGT) protection

We import any Exhaust Gas Temp sensors that can output a 0 - 5volt signal through any of the 7 different ECU inputs. MoTec offer a known quality sensor suitable for this application.

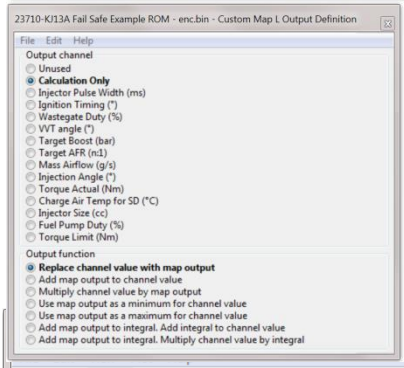
For this example we have imported 2 x EGT sensor voltage outputs through the MAF sensors Bank #1 (B1) and Bank #2 (B2). The EGT sensor voltage is converted to Temp Deg C.

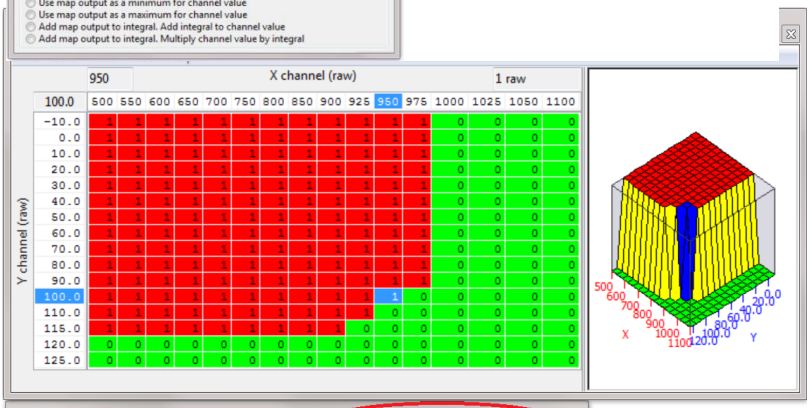
Custom Map L – EGT Fail Safe

- X axis is MAF Volts B1
- Y axis is MAF Volts B2
- Converts EGT Volts to deg C

Custom Map L will output the highest EGT reading, so in this example B1 is at 3v (660deg C) but Bank #2 is only at 2 volts (440deg C).
The output will be the higher reading at 660deg C.

The Map Activation has been set against Engine Load and the map will only work over 150% and a delay of 2 seconds, it will de-active below 80% Engine Load.

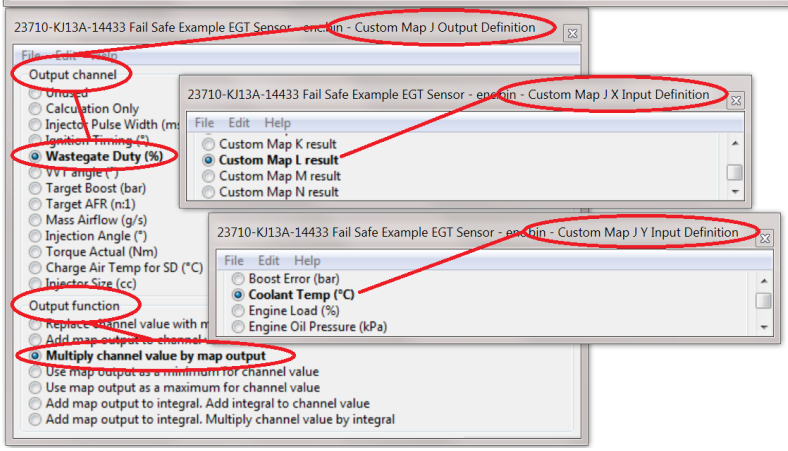




The output of Map L will be **Calculation Only**; it is now imported into **Custom Map J** which will reduce WG Duty for the highest EGT reading and Coolant temp.

As shown in this example at 100deg C Coolant temp the WG Duty will be reduced to zero as EGT climbs from 950 to 975degC.

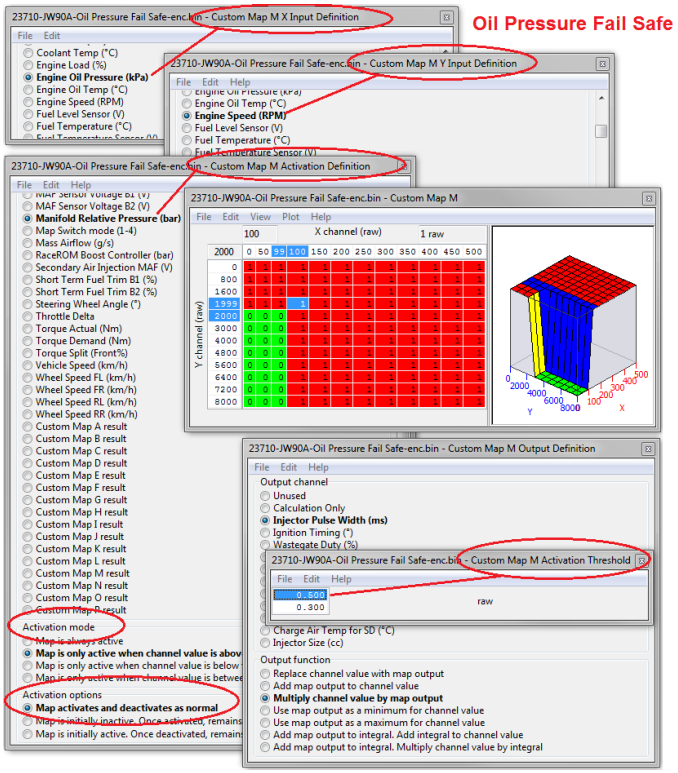
At higher Coolant temps the WG Duty will be reduced at an even lower EGT providing a duel fail safe protection against temperature.



An alternate output for high EGT could be to add fuel and maintain power rather than reduce WG Duty and reduce power.
It's also possible to import 6 different EGT sensor signals but this would use 6 of the 7 available inputs.

Oil Pressure Fail Safe

We can create a custom map against Oil Pressure and Engine Speed, should the Oil Pressure drop below a certain amount then we can take severe action to protect the engine in form of a fuel cut.



Custom Map M – Oil Pressure Fail Safe

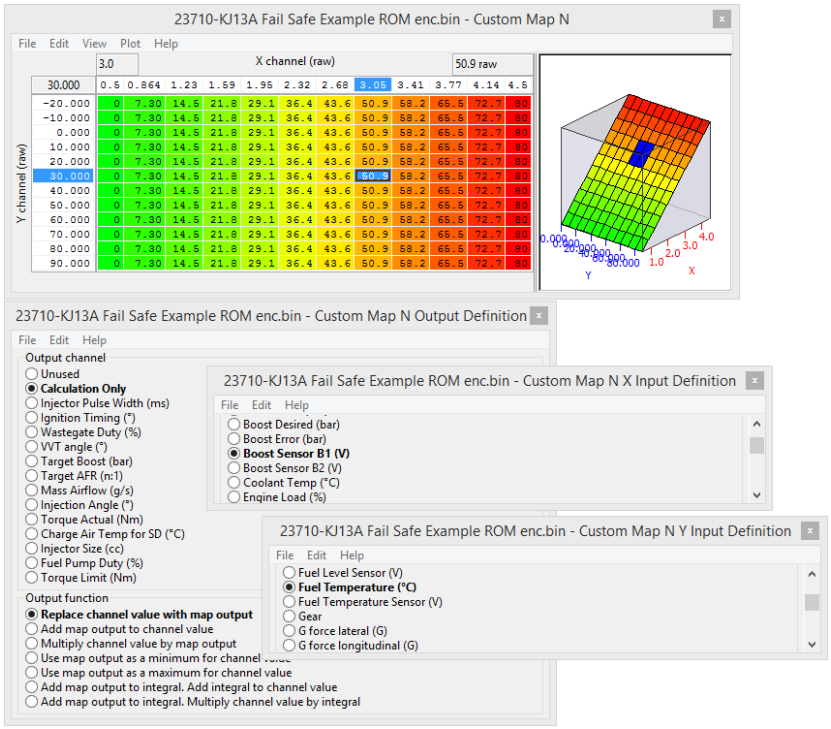
- X axis is Engine Oil Pressure
- Y axis is Engine Speed
- The map values will multiply the current Injector Ms if the oil pressure drops on load.

The Activation Threshold can be set so it only activates on full throttle, or over a certain engine load or boost pressure, a certain oil temp or a certain vehicle speed, the options are many.

If the Oil Pressure does drop then the Fuel Injectors will be cut immediately to minimise any potential engine damage, we would suggest a 1 second delay period before map activation to avoid transient conditions.

Fuel Pressure (using a 3rd party sensor) Fail Safe

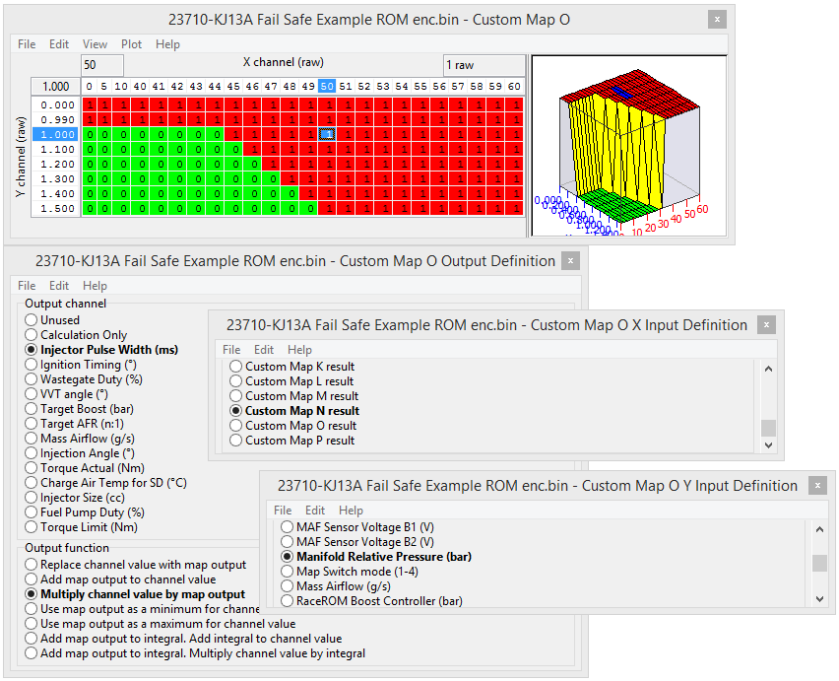
By fitting a 3rd party Fuel Pressure sensor we can import this into the ECU and set up a fail safe against fuel pump failure.
We have tested the Got Boost Performance plug and play kit that worked very well and imports the Fuel Pressure signal through the Boost Sensor #1.



Custom Map N – Fuel Pressure Fail Safe

- X axis is Boost Sensor Volts B1
- Y axis is Fuel Temp Deg C
- Shows Fuel Pressure in Bar *10

Custom Map N shows the Fuel Pressure in Bar * 10, in this example the fuel pressure sensor signal has been imported through the Boost Sensor Bank 1 and 3.05 volts is actually 5.09 bar, this has been multiplied by 10 so 5.09 is actually 50.9 for the reason of displaying the Fuel Pressure on the Coolant Temp gauge using gauge Hijack. The Fuel Temp Y axis has been added but this map has not be calibrated for any temp compensations.



Custom Map O – Fuel Pressure Fail Safe Fuel Cut

- X axis is Fuel Pressure Bar *10
- Y axis is Manifold Relative Pressure
- Will cut the fuel injectors

As the static fuel rail pressure is 4 bar (40 in the map) then 1 bar boost will increase the fuel pressure to 5 bar (50 in the map).
In the Map O example if fuel pressure drops more than 0.5bar below what's expected (so below 45 when it should be 50) then the fuel injector will be cut momentarily alerting the drive to a fuel pressure problem.

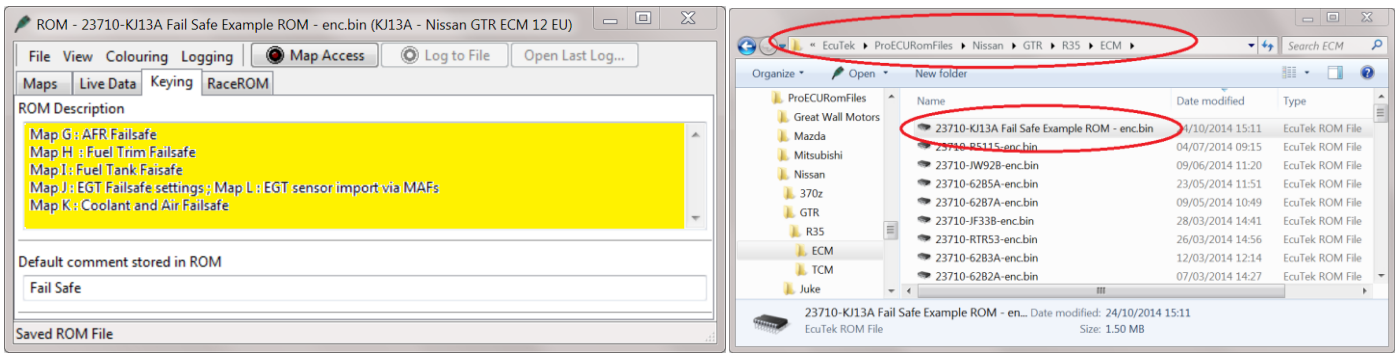
As the 2nd fuel pumps are a known issue on the GTR this is a critical fail safe protection.
But this fuel cut is quite extreme it could destabilise the vehicle if corning hard so we strongly suggest that this Fuel Pressure fail safe is used in conjunction with Fuel Trim and AFR fail safe maps so the power is reduced before any fuel cut will occur.

Fail Safe Summary

There are many other fail safe protections that can be created, our examples are mainly reducing the Wastegate Duty to reduce power output when over a certain load but this can be configured as desired by the tuner. The example fail safes shown above are configured in the ROM file called "23710-KJ13A Fail Safe Example ROM - enc.bin" that's available on EcuTek Update, the ROM will be found here on your laptop.

C:\EcuTek\ProECURomFiles\Nissan\GTR\R35\ECM\23710-KJ13A Fail Safe Example ROM - enc.bin

Each custom map is defined under the Keying section and the example can be copy and pasted into your tuned ROM as required.



Additional inputs could be fuel pressure sensors, exhaust pressure sensors or pressure differentials between banks, across Intercoolers or across the throttle bodies; all this is possible with Custom Maps.

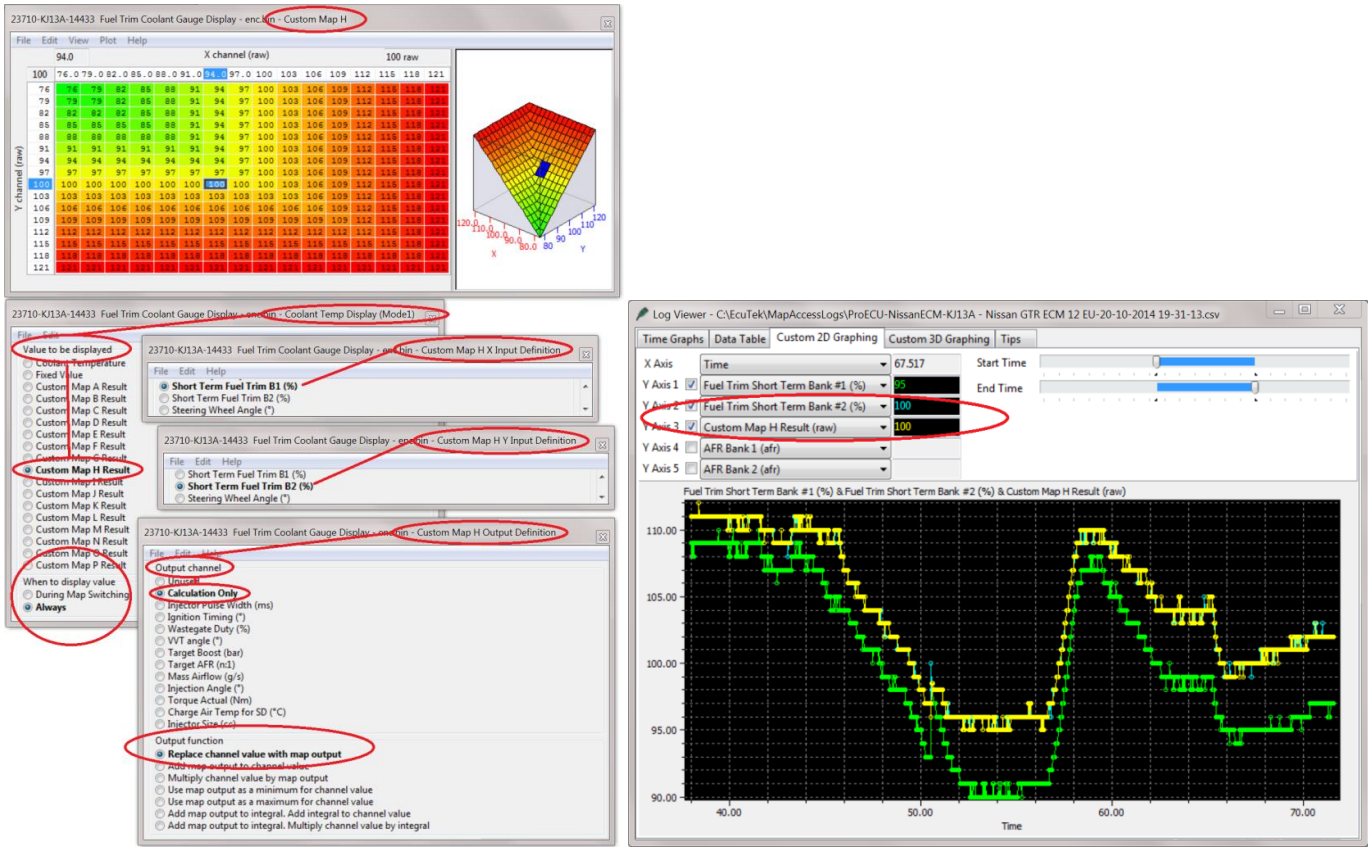
Coolant Temp Display Hijack (MFD)

We can use the Coolant Temp Gauge in the Multi Function Display (MFD) to show values other than Coolant Temperature by using custom maps. Here are some suggestions of what can be displayed along with a few examples.

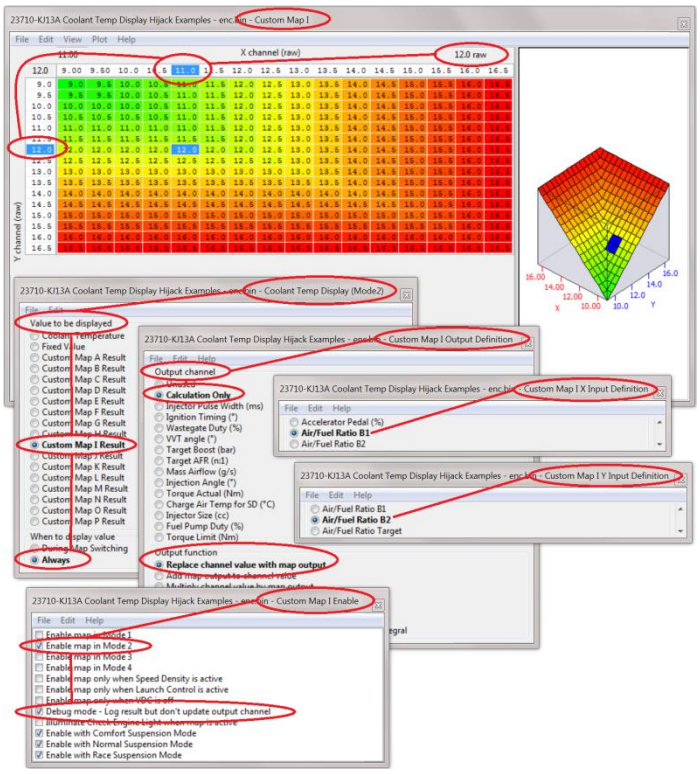
- Fuel Trim Short Term
- AFR
- Lambda
- Ignition Timing
- Wastegate Duty
- Ethanol Content Ratio
- Engine Torque Output

Fuel Trim Short Term

Custom Map H will output the highest reading Short Term Fuel Trim from B1 or B2.
The result of Custom Map H will be displayed on the Coolant Temp Display in Mode 1 **Always** (and not just during **Map Switching**).
You can see the log file shows B1 is 95% FTST but B2 is at 100% STFT so Custom Map H Result is 100 and the Coolant Temp Gauge will show 100deg C indicating 100% is the highest FTST maximum value.



AFR or Lambda



Custom Map I will output the leanest AFR from B1 or B2. The result of Custom Map I will be displayed on the Coolant Temp Display in Mode 2 **Always** (and not just during **Map Switching**).

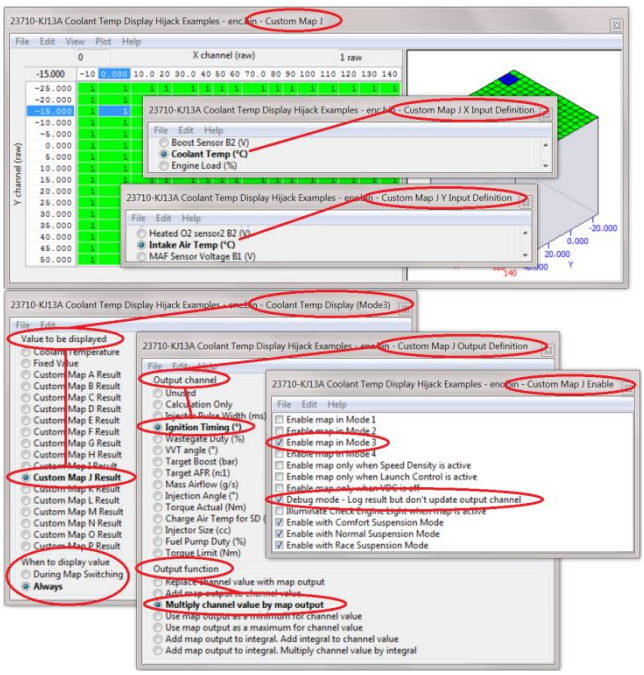
So if the B1 is 11:1 but B2 is 12:1 AFR then the leaner value 12:1 AFR will be shown.

As the coolant temp gauge reads between 50 to 130deg C and doesn't show decimal places the map values could be increase by +100 so 12:1 would show 120.
This requires another custom map to import the result of Map I and multiply it by 10 (so 12.3AFR would be shown as 123).
Or the values could be converted to Lambda so 13:1 would show 88deg C (indicating 0.88 Lambda). To do this you simply fill map I with Lambda values instead of AFR values, so the value of 12:1 shown in the map above would be 0.81 Lambda and could be shown as 81deg C.

IMPORTANT: Leaving the DEBUG box checked means all the calculations happen and we can log the Output (Custom Map H Result in Live Data), we can also use the Output calculation for another custom map etc but with the debug box checked the parameter does not actually get rewritten, overwritten or changed in any way.

Ignition Timing

Custom Map J will output the current Ignition Timing. The result of Custom Map J will be displayed on the Coolant Temp Display in Mode 3 **Always**.



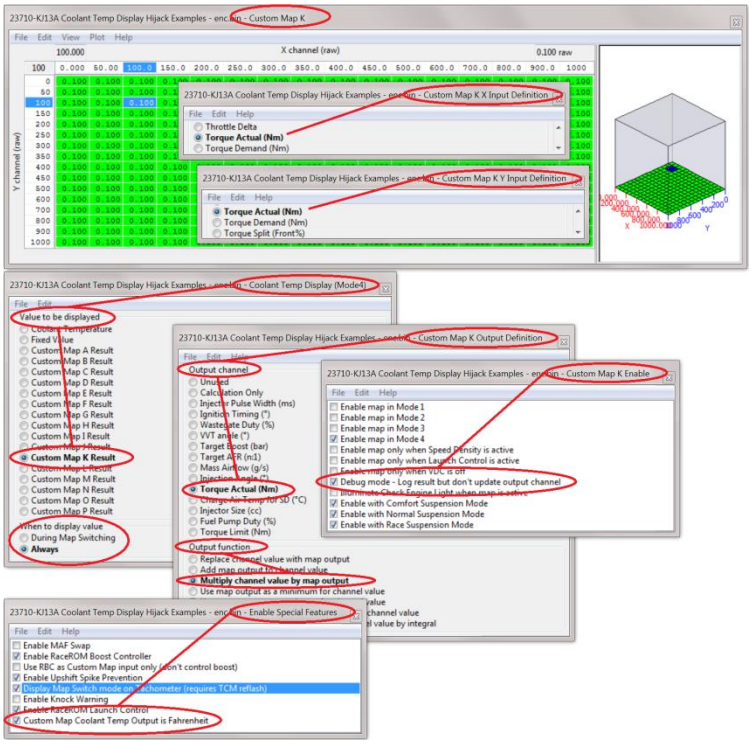
The important thing to note here is there is no Ignition Timing input definition parameter.
So the X or Y axis are configured as Coolant Temp and Intake Air Temp for no reason other than an axis Input definition needs to be chosen.

The Output will be Ignition Timing and the Ignition Timing will be multiplied by 1 (so it will not change the Ignition Timing) see that the DEBUG MODE box is left checked so the map cannot work but we **can** use the Ignition Timing value Output to write on the coolant temp gauge.

Leaving the DEBUG box checked means all the calculations happen and we can log the Output or use the Output for another map etc but the parameter does not actually get rewritten, overwritten or changed in any way.

Engine Torque

Custom Map K will output the current Engine Torque but multiply it by 0.1. So if the current torque is 800Nm then the coolant temp display will show 80.

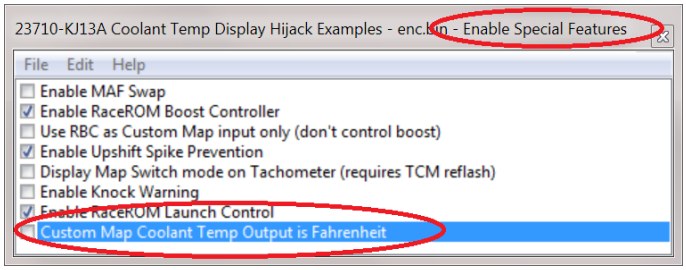


The result of Custom Map K will be displayed on the Coolant Temp Display in Mode 4 **Always** (and not just during **Map Switching**).
This example also has the Fahrenheit option selected for US region vehicles.

The X and Y axis inputs are Engine Torque (Torque Actual) and are only scaled to 1000Nm in this example, higher output engines can be rescaled over 1000Nm if required.

It's important to note that the DEGUG box is still selected as we do NOT want to overwrite the Engine Torque with a value that's 10% of the true value (or the gearbox control will be seriously poor and the clutches will slip uncontrollably!).

As US region models show Coolant Temp as Fahrenheit instead of Centigrade this causing some problems (as 100DegC would be displayed as 212F). It is possible to create a custom map to convert C to F but it's difficult to configure.



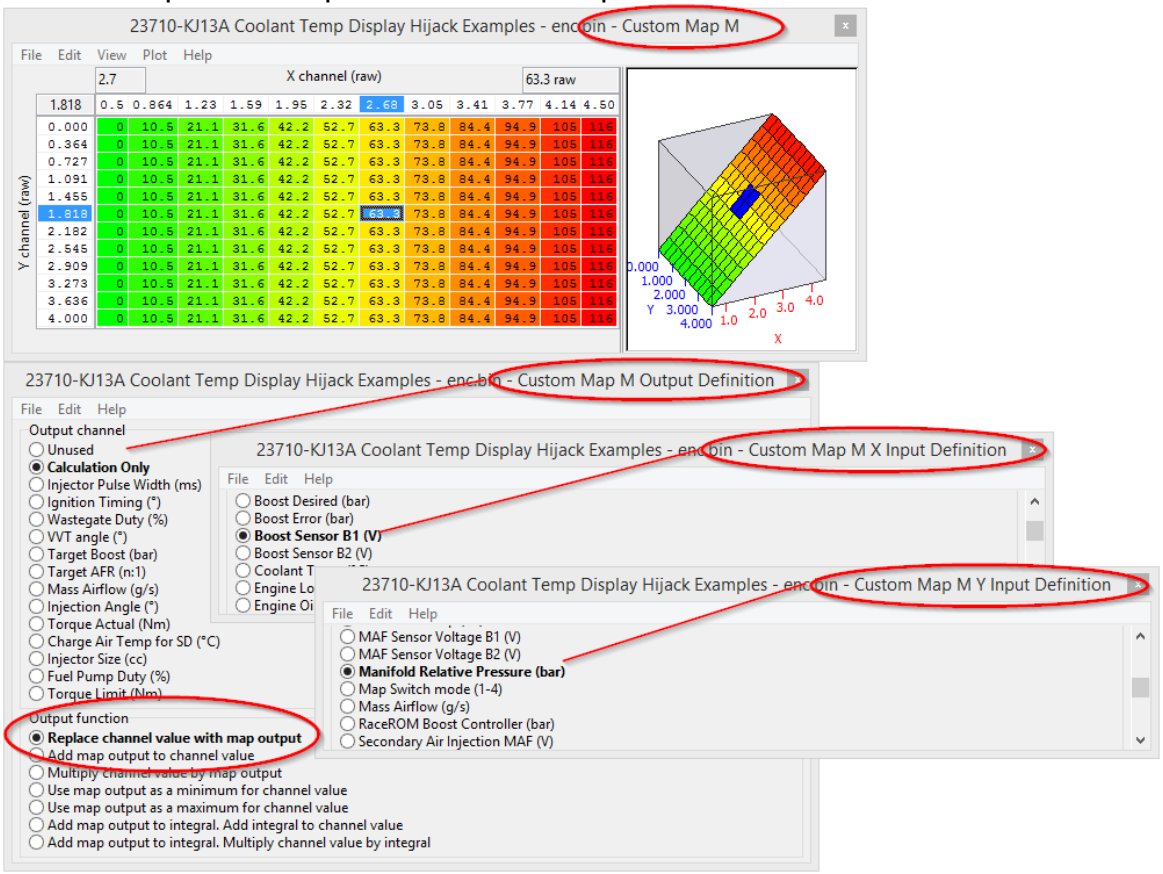
On the latest RaceROM Feature Files (RRFF) there is an option for US region vehicles to show the correct value found under Enable Special Features section.
So 100% Fuel Trim would normally show as 212F but if we check the box then it will be shown as 100 as intended.

Fuel Pressure (using a 3rd party sensor)

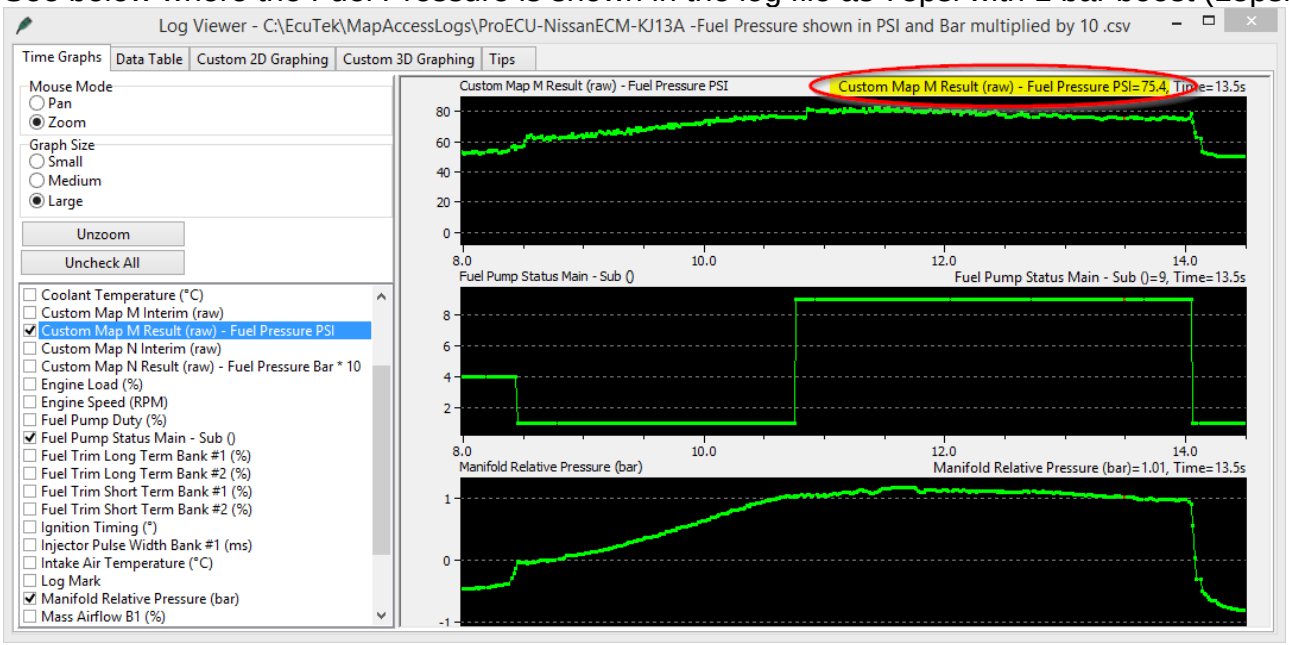
By fitting a 3rd party Fuel Pressure sensor we can import the signal and display it on the MFD.
We tested the Got Boost Performance plug and play kit that worked very well and imports the Fuel Pressure signal through the Boost Sensor #1.
The static GTR fuel pressure at sea level with no vacuum line connected is 4 bar (60 psi), this value will drop when the vacuum line is connected (assuming the engine is running that is).
Fuel pressure will rises and fall relative to Manifold Pressure, with 1 bar boost (2 bar absolute) the fuel pressure will rise from 4bar to 5bar (60psi to 75psi).

Display Fuel Pressure as PSI

Custom Map M will output the current fuel pressure in PSI.

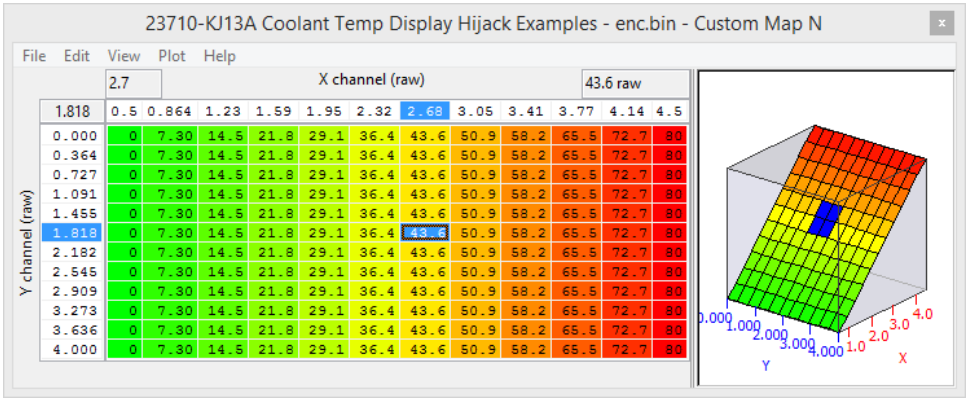


See below where the Fuel Pressure is shown in the log file as 75psi with 1 bar boost (15psi).

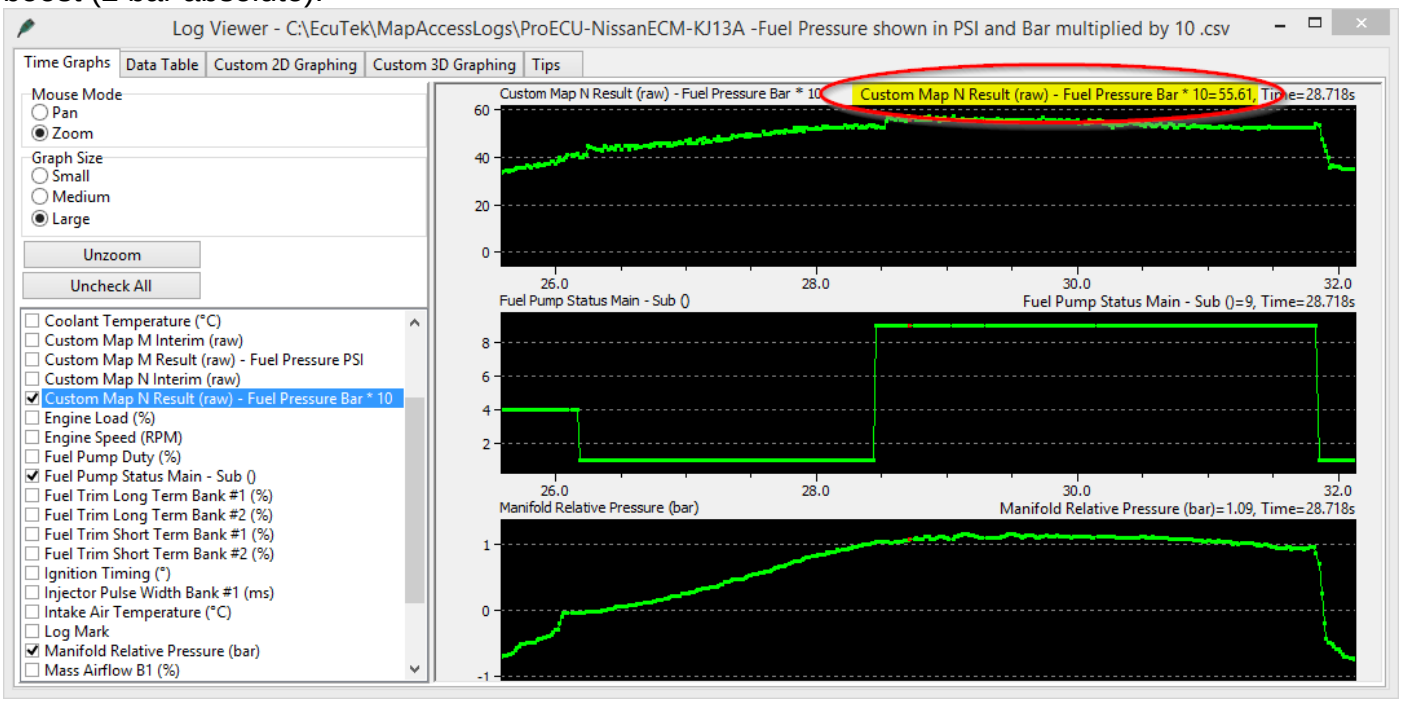


Display Fuel Pressure as Bar

Custom Map N will output the current fuel pressure in Bar multiplied by 10 (so 4.3bar would be displayed as 43 Deg C). All other setting are the same as Custom Map M above.

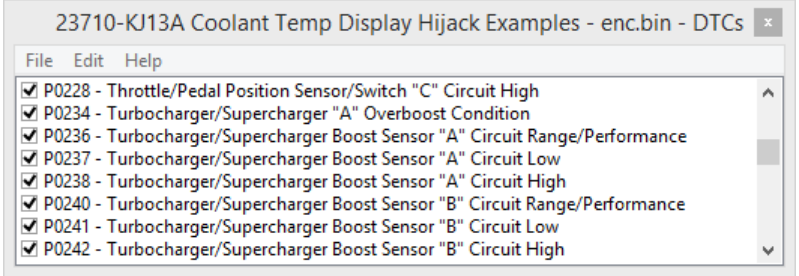


See below where the Fuel Pressure is shown in the log file as 55.6 indicating 5.56 bar with 1 bar boost (2 bar absolute).



Remember that for US region models show Coolant Temp as Fahrenheit instead of Centigrade the Enable Special Features check box for Fahrenheit should be selected so the Fuel Pressure is shown correctly.

When using a plug and play Fuel Pressure sensor conversion through Boost Sensor #1 the Pre-throttle boost sensor can no longer be used for boost control (or a boost limit) and in this case the Custom Maps Boost Control should be used as shown in the GTR Tuning guide and calibrated in the GTR Example ROMs.

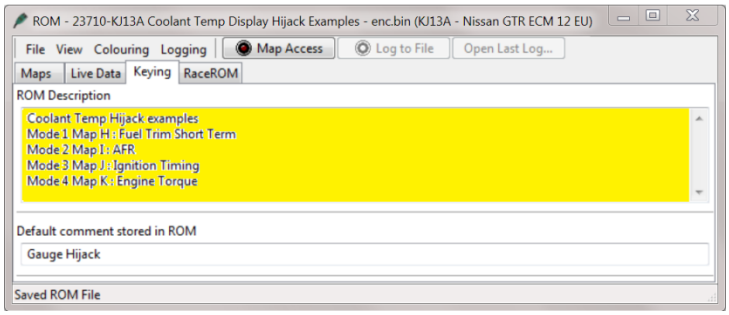


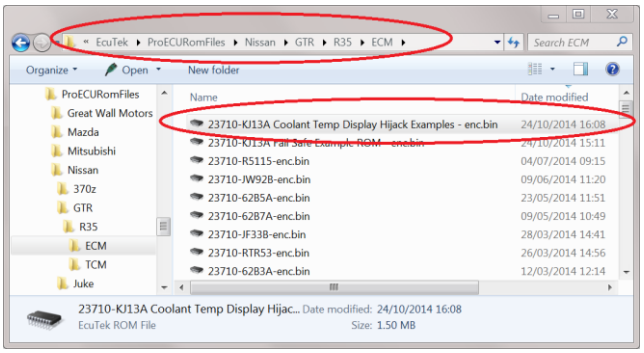
When using Boost Sensor #1 or #2 for Fuel Pressure or Charge Air then be sure to disable DTCs P0236 or the voltage will not read correctly, NOTE that this DTC does not illuminate a CEL and the channel will not update in Custom Maps if this DTC is not disabled.

The Coolant Temp Gauge Hijack examples shown above are configured in the ROM file called “23710-KJ13A Coolant Temp Display Hijack Examples - enc.bin” is available on EcuTek Update, the ROM will be found here on your laptop.

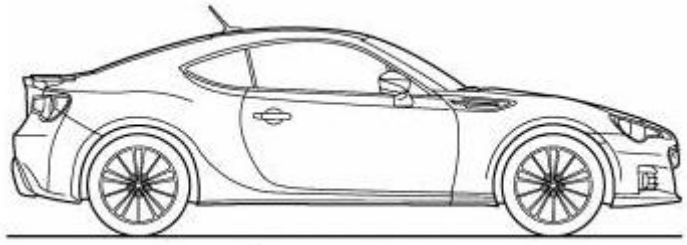
C:\EcuTek\ProECURomFiles\Nissan\GTR\R35\ECM\23710-KJ13A Coolant Temp Display Hijack Examples - enc.bin

Each custom map is defined under the Keying section and the example can be copy and pasted into your tuned ROM as required.





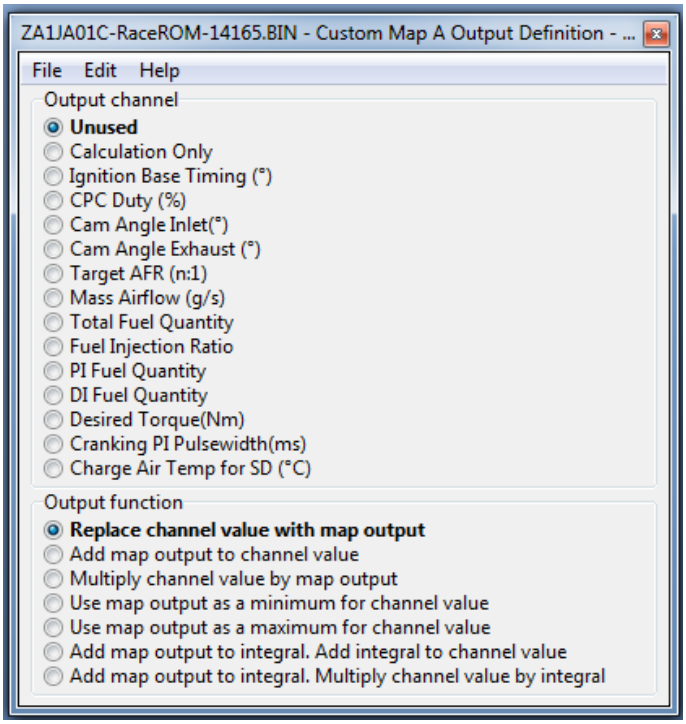
BRZ/GT86/FR-S Specific



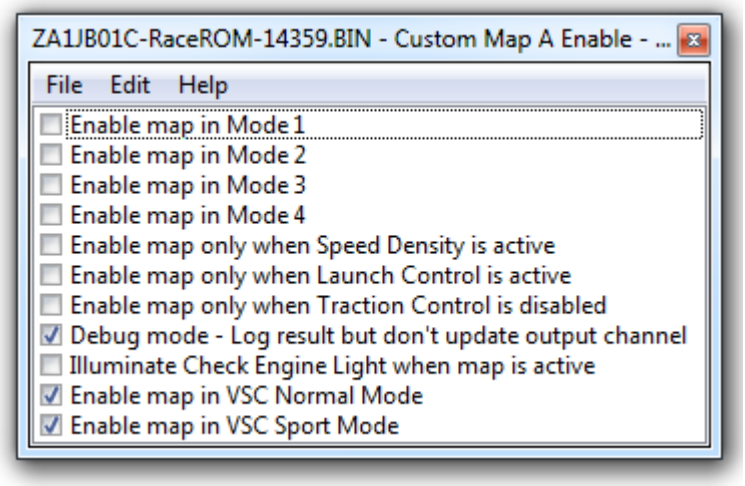
Control Maps Overview

Input Channels

Output Channels



Enabling custom maps



Each custom map has its own enable map. You must select the map switch modes in which you want the custom map to be used. At least one of these must be selected to enable the map.

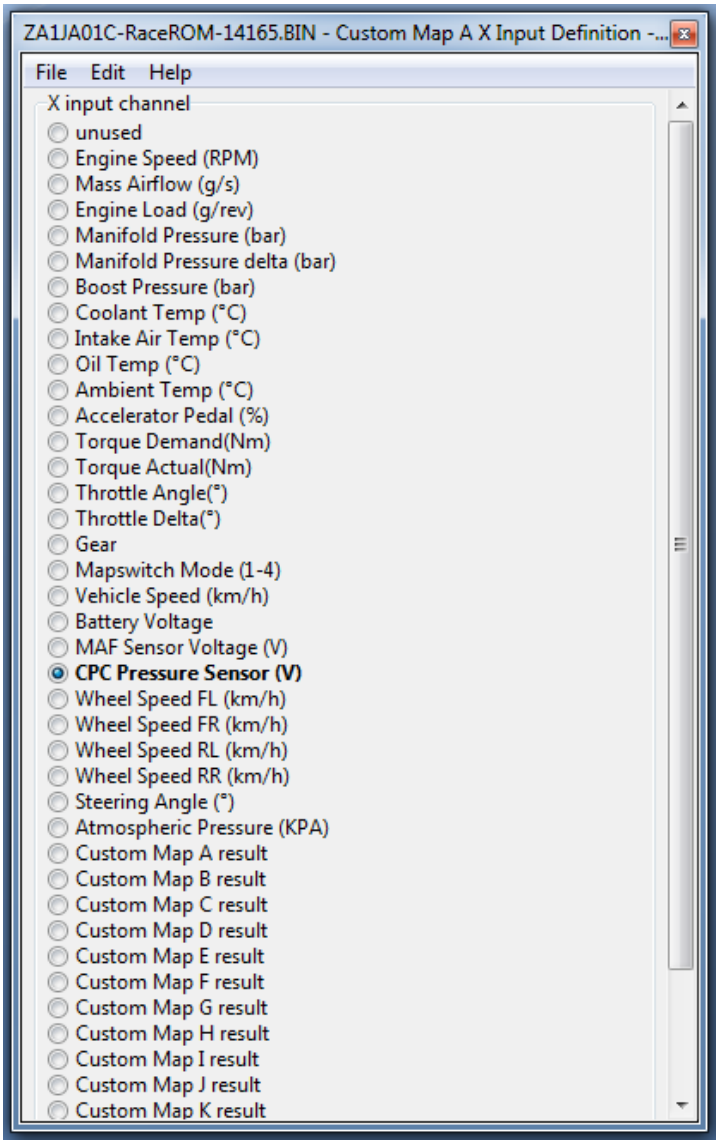
You can specify that the map is only active when the car is running in RaceROM Speed Density mode, when Launch Control is active, when Traction Control is disabled.

The map can also be enabled based on the VSC mode. By default the map will operate in Normal and Sport modes. At least one of the VSC boxes must be selected to enable the map.

You can also select to illuminate the Check Engine light when the map is active. This can be used to warn the driver of a specific condition (e.g. overboost or lean AFR), or simply as an aid to debugging.

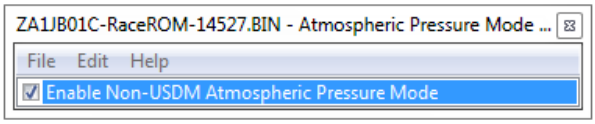
Auxiliary inputs

The "CPC Pressure Sensor voltage" is provided as an input to the custom maps. This measures a signal between 0 and 5 volts on pin C20 of the ECU. See the wiring diagram below.
This signal normally comes from the canister pump module, which is non-essential, and only fitted in some markets. You can remove the module (if fitted) and utilise this input for your own sensor such as charge air temperature or fuel ethanol content.

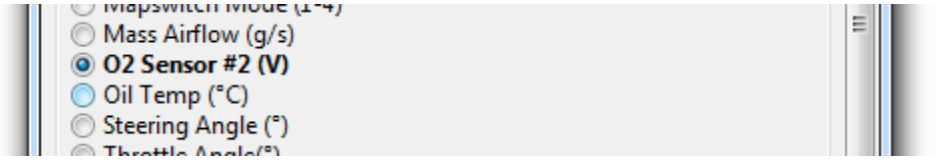


Important note regarding repurposing of the CPC Pressure Sensor input. USDM variants (C,D,E and F) of this vehicle use the CPC Pressure Sensor to derive the Atmospheric Pressure Reading. Other variants use the MAP Sensor instead.

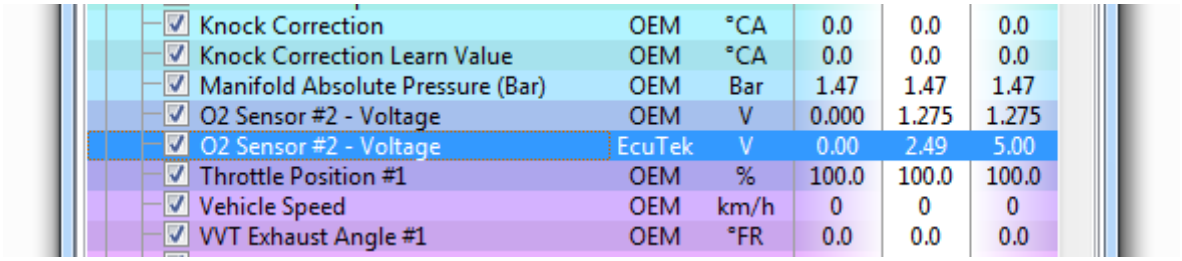
If you repurpose the CPC Pressure Sensor input on a USDM vehicle then the Atmospheric Pressure calculation will be incorrect. We have added a checkbox on affected vehicles to force the ECU to use the MAP sensor for the Atmospheric Pressure Calculation. Please enable this feature when repurposing the CPC Pressure Sensor on a USDM vehicle.



It is also possible to use the Rear O2 sensor as an additional custom map input. This measures a signal between 0 and 5 volts on pin B21 of the ECU. See wiring diagram below.



When logging this value be sure to use the EcuTek “O2 Sensor #2 – Voltage” parameter, because the OEM parameter of the same name displays a maximum of 1.275volts, even when the actual voltage is higher.



Knock Correction	OEM	°CA	0.0	0.0	0.0
Knock Correction Learn Value	OEM	°CA	0.0	0.0	0.0
Manifold Absolute Pressure (Bar)	OEM	Bar	1.47	1.47	1.47
O2 Sensor #2 - Voltage	OEM	V	0.000	1.275	1.275
O2 Sensor #2 - Voltage	EcuTek	V	0.00	2.49	5.00
Throttle Position #1	OEM	%	100.0	100.0	100.0
Vehicle Speed	OEM	km/h	0	0	0
VVT Exhaust Angle #1	OEM	°FR	0.0	0.0	0.0

Rear 02 sensor input signal is shown below (OX1B) – ECM Pin B21

A34

	1	2	3	4		5	6		
7	8	9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24	25	26	27
28	29	30			31	32	33	34	35

: Indicates the wiring color.

Wire colors are indicated by an alphabetical code.

Copper wires

B	= Black	W	= White	BR	= Brown
L	= Blue	V	= Violet	SB	= Sky Blue
R	= Red	G	= Green	LG	= Light Green
P	= Pink	Y	= Yellow	GR	= Gray
O	= Orange	BE	= Beige	DG	= Dark Gray

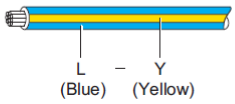
Aluminum wires

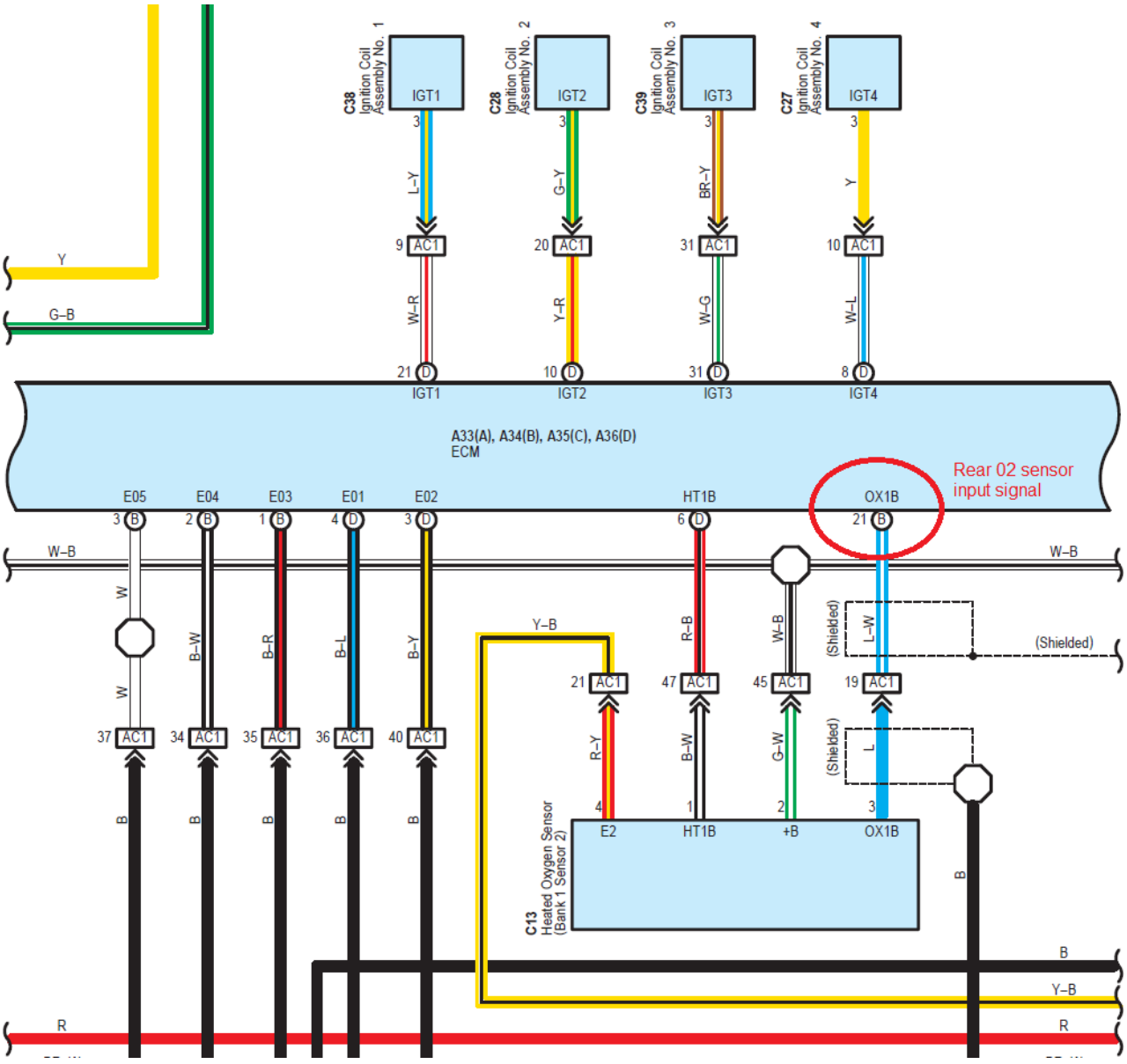
LA = Lavender

NOTICE:Do not splice into aluminum wires for power sources or signals.

The first letter indicates the basic wire color and the second letter indicates the color of the stripe.

Example: L – Y





CPC Pressure Sensor voltage is shown below (PPMP) – ECM Pin C20

A35

1	2			3	4		5		6		7
8	9	10	11	12	13	14	15	16	17	18	19
20	21	22	23			24	25			26	27
28	29	30	31			32	33			34	35

: Indicates the wiring color.

Wire colors are indicated by an alphabetical code.

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P	= Pink	Y	= Yellow	GR	= Gray
O	= Orange	BE	= Beige	DG	= Dark Gray

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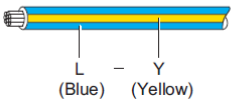
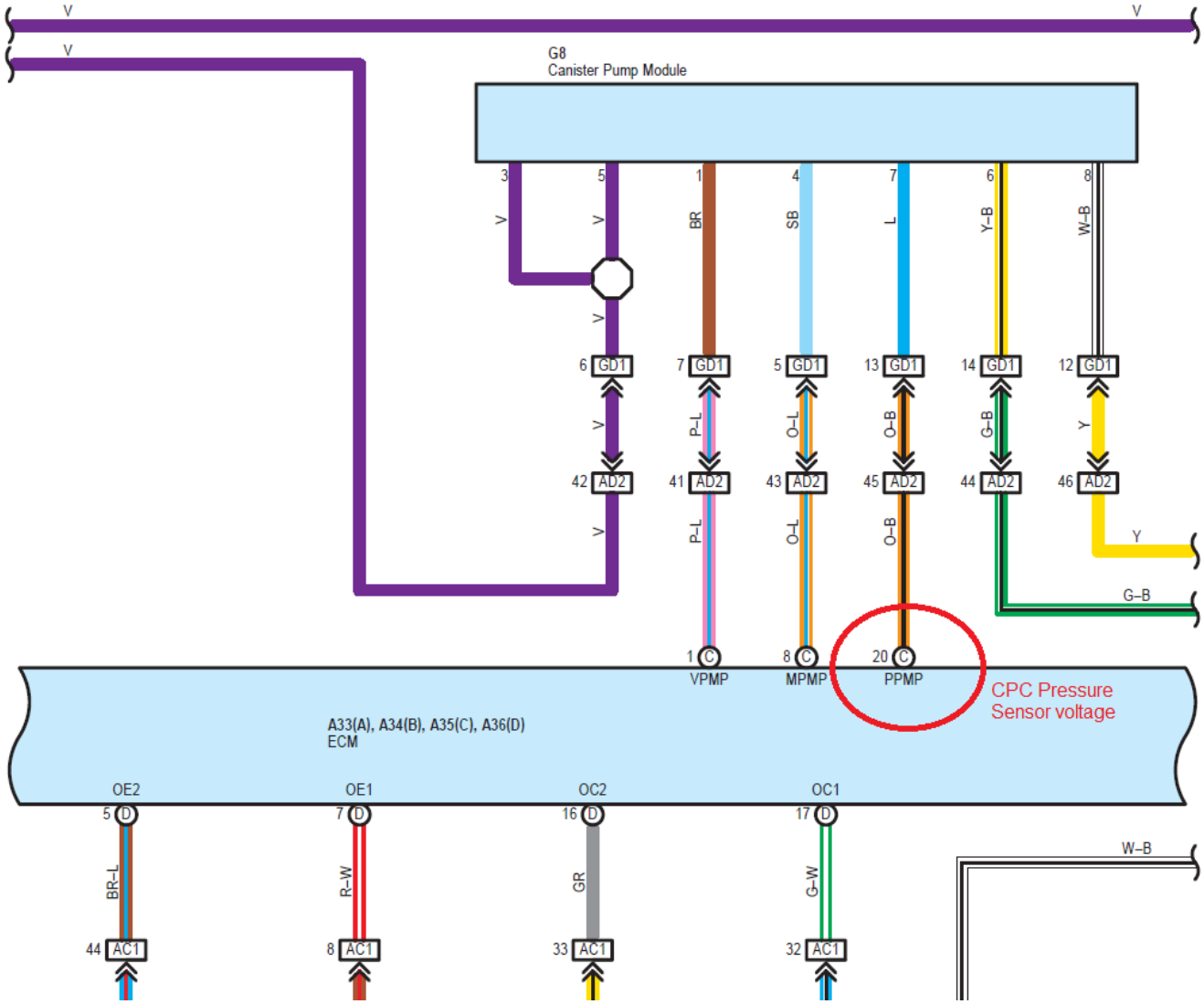
The first letter indicates the basic wire color and the second letter indicates the color of the stripe.

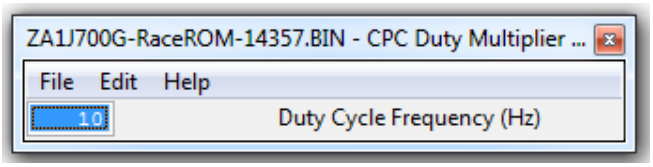
Example: L – Y



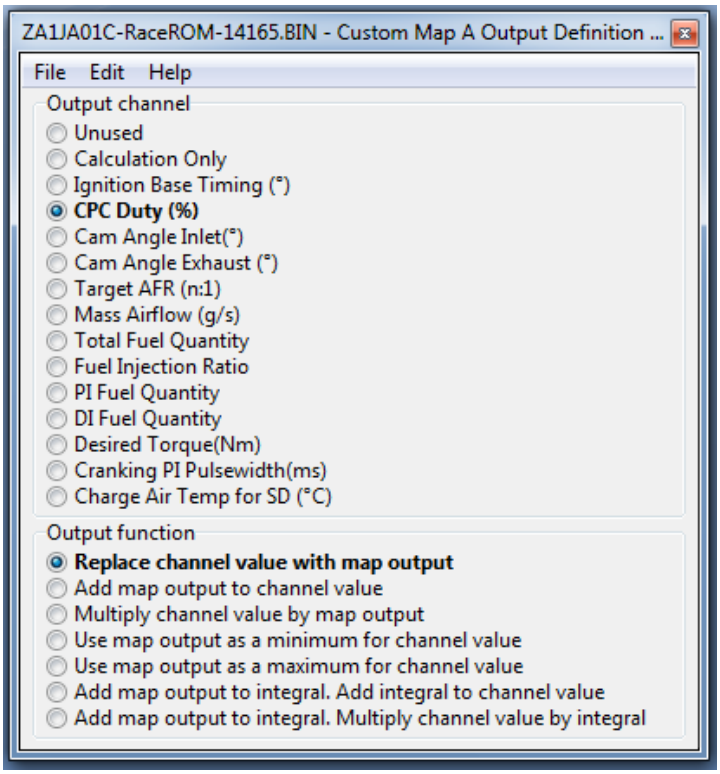


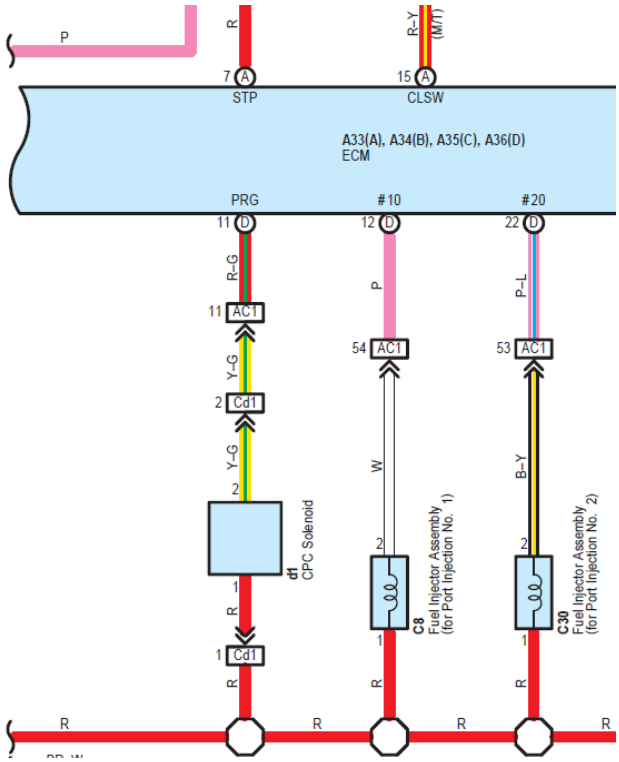
Duty Cycle Output

The "CPC Duty (%)" output can be used to drive a wastegate solenoid, nitrous solenoid or anything else requiring a 12volt duty cycle. A Subaru 2 port solenoid (part no.16102AA360) was used for our testing and plugs directly into the CPC valve wiring!



The frequency of the solenoid should be adjusted by the “CPC Duty Multiplier” map in order to obtain the best result for your application. Most WG Duty solenoids work best around 30% to 35% Hz.





BRZ Custom Maps

There are many uses for Custom Maps on the BRZ/FR-S models many of these are defined in the dedicated BRZ Tuning Guide as shown below. Please see the relevant section for more information on the features shown below.

Boost Control

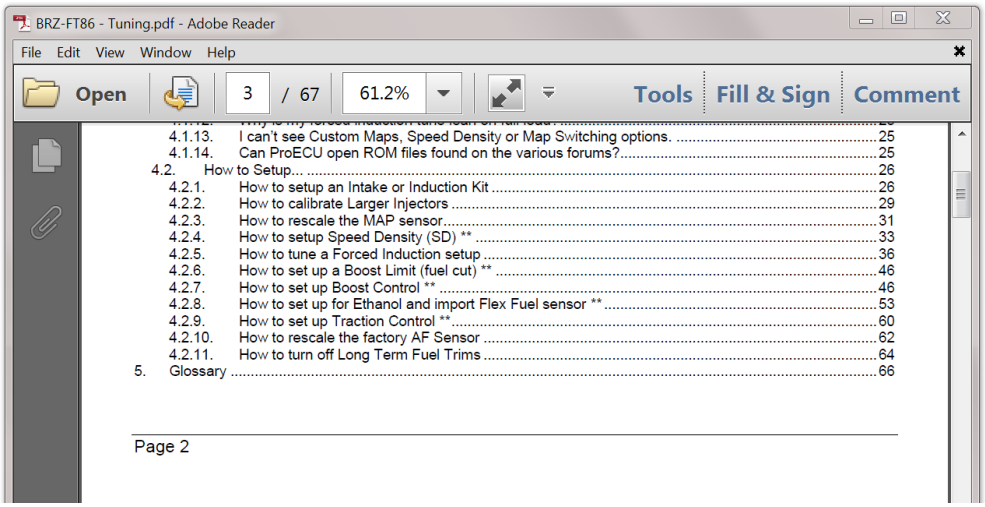
See the ‘How to setup Boost Control Section’ of the BRZ Tuning Guide.

Flex Fuel Sensor Import

See the ‘How to setup for Ethanol and import Flex Fuel sensor’ section of the BRZ Tuning Guide.

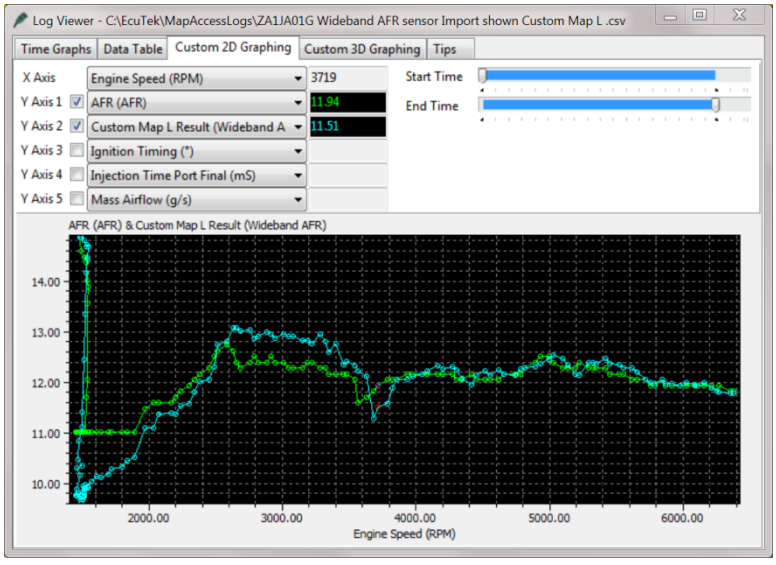
Traction Control

See the ‘How to setup Traction Control’ section of the BRZ Tuning Guide.



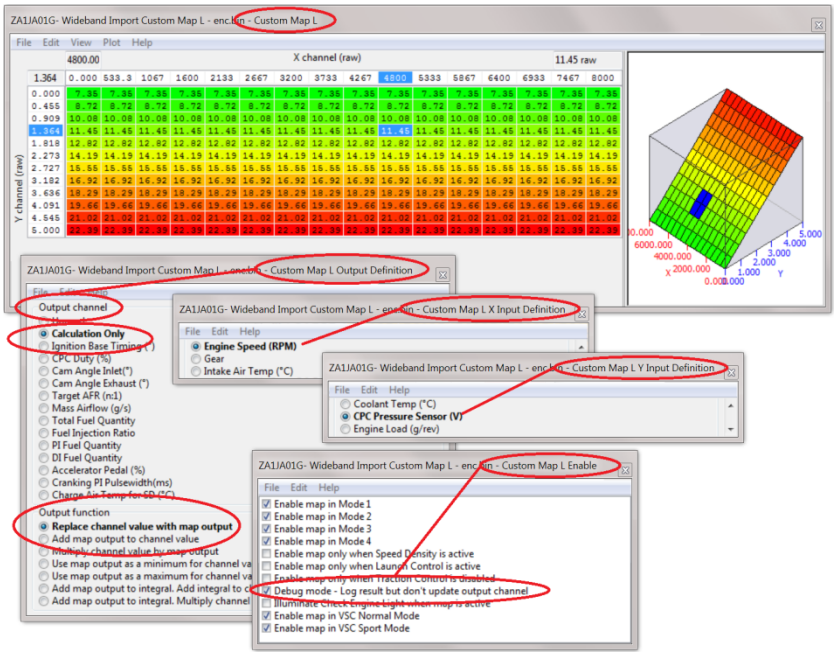
Wideband AFR Sensor Import

You can import any aftermarket wideband AFR sensor that has a calibrated 0-5v output.
This will provide more accurate and reliable AFR readings than the factory widerange sensor, we also recommend that you resacle the factory AF sensor.



The example on the left shows the factory AF sensor reading below 12:1 AFR and also shows the Wideband Sensor Import through custom maps, this feature has enabled tight calibration of the factory AF sensor.

See the BRZ Tuning Guide section 4.2.10 for further info on ‘How to rescale the factory AF Sensor‘ to read more accurately.



In this example we have configued Custom Map L to import a Innovate MTX-L Gauge output and create a AFR value.

The Y axis shows the 0 – 5 volt input from the wideband gauge and Custom Map L converts the voltage to an AFR. The values in the map could also be Lambda if preferred.

You will see that Custom Map L is enabled in all modes but the DEBUG check box is still checked, this means the output of the map will simply be an AFR value that can be used with other Custom Maps or displayed on the Coolant Temp gauge.

By having the True Wideband Custom Map input you can make various decision's, here are some examples.

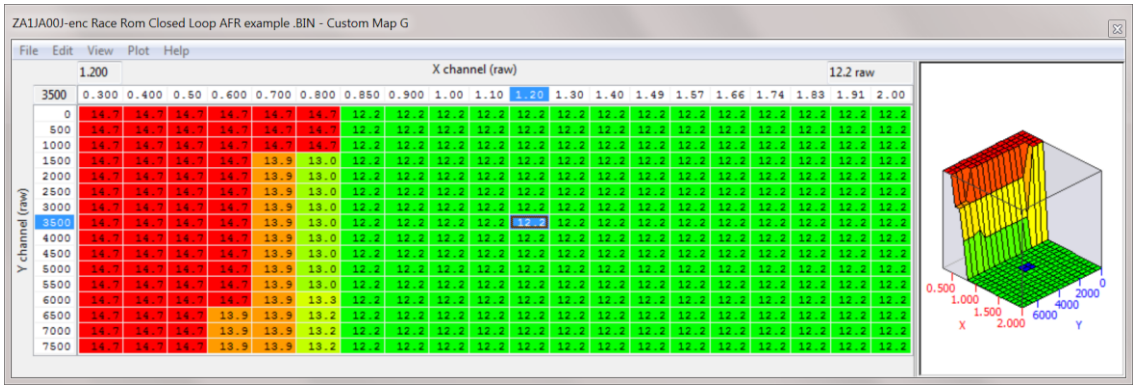
- Increase the Injection Volume for a Lean AFR
- Put the CEL on for a Lean or Rich condition
- Retard the Timing aggresively to reduce power
- Reduce the Accel Pedal output to close the throttle
- Dramatically reduce wastegate duty for turbocharged vehicles

All these safety features might just save an engine one day.

Closed Loop Fuel Control

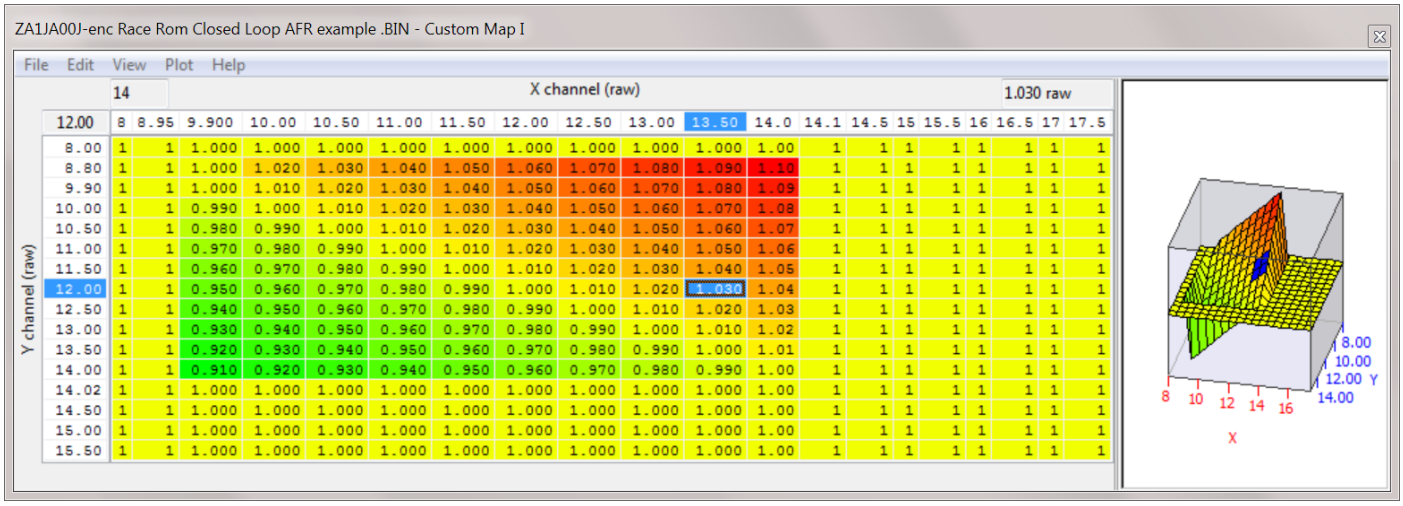
By using the Wideband sensor import its possible to make closed loop fueling on full load.
You would calibrate your fueling as normal (see section 4.2 of the BRZ Tuning guide) and once the AFR is profiled (Target AFR as such) then add these AFR readings into a Custom Map against RPM and Load (a copy of your fuel map as such) if you're your MAF scaling is correct and your Fuel Map actually matches your true AFR then use the output of this Custom Map as the Input to another Custom Map.

The example below for Custom Map G shows a AFR map that matches the base fuel map and its used to create a Target AFR that can be compared to the wideband sensor reading and therefore adjust the Injection Volume amount to hit the Target AFR. The X axis is Engine Load and the Y axis is RPM. The Output is Target AFR but its left in Debug mode so the channel is **not** updated.

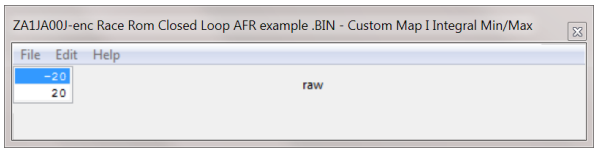


So when the Wideband AFR reading is leaner than the Target AFR then the fuel volume amount would be increased.
When the Wideband AFR is richer than the Target AFR then the fuel volume amount would be reduced.
In the example below the Y axis is the output of Map G (Target AFR) and the X axis is the Output of Map H (Wideband sensor AFR).
If the Target AFR is 12:1 and the Wideband AFR is 13.5:1 then the Injection Volume will be increased by 3% (Multiplied by 1.03) , if this is added as an integral output then the Injection Volume will continue to increase until the Wideband AFR equals the Target AFR. Though these values would need to be reduced significantly if added as an Integral.

You will see the map can only work between 10:1 AFR and 14.0:1 AFR, so if the wideband reading is richer or leaner than this the output is 1 so the Injection Volume will not change.



The compensation could be an Integral addition/subtraction for a proper closed loop control (though you would want to set a min and max for the Integral amount). We would suggest an Integral Min/Max of 20%.



We would suggest the custom map is only allowed to make changes on full load so set a Map Activation of say 0.9 Engine Load or higher with a 1 second time delay.

As shown above the map will only work when the AFR is within a certain range of the Target AFR so if the sensor fails or the values are unrealistic then the closed loop control simply doesn't work.

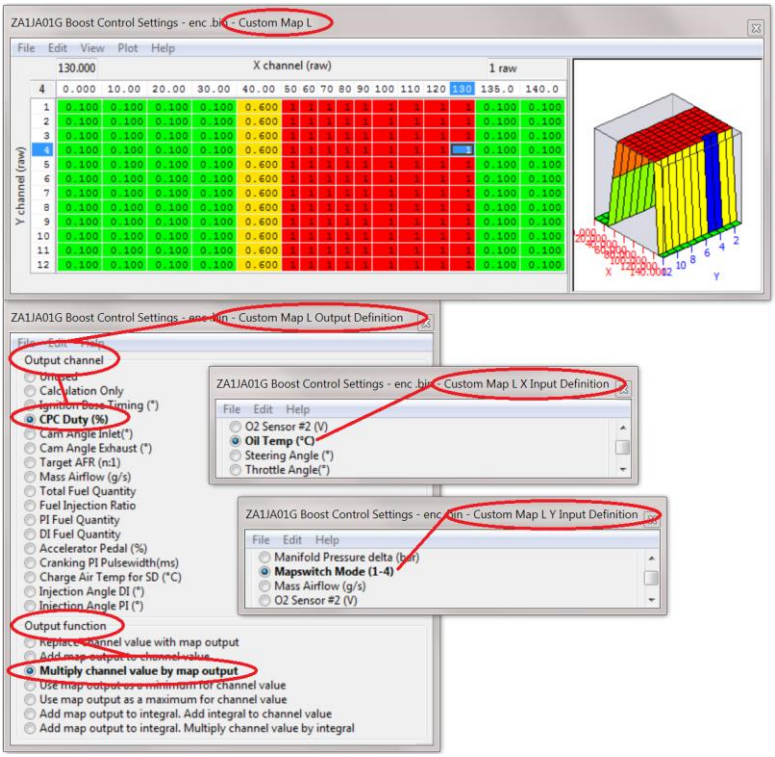
Fail Safe Protection

AFR

Its possible to create a Custom map that would illuminate the CEL or close the throttle should the wideband AFR reading go leaner than 13.5:1 AFR or richer than 10:1 AFR when you are on full load with the map only active over a certain engine load (full power). This map can be configured in the same way as the GTR example and if the AFR runs leaner than a specified amount at a certain RPM/Load then you close the throttle to protect and save the engine.

Oil Temp

When the Oil is not up to temperature we can reduce the Wastegate duty on turbocharged models.



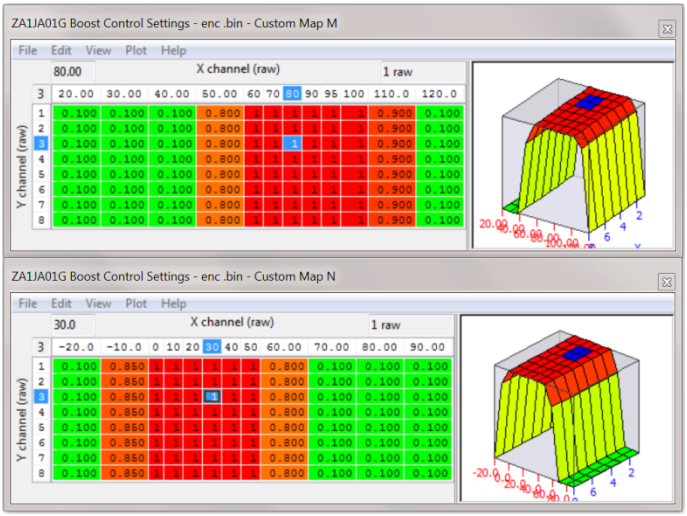
Custom Map L below has been configured to multiply the WG Duty dependant on the current Oil Temp (X axis) and the current Map Switch mode selected (Y axis).

This map could also be used to illuminate the CEL if the Oil Temp exceeds a certain temp using the Map Activation feature and setting a specific Oil Temp.

Air and Coolant Temp

Additional safety maps can be configured as shown below, this includes activation control that would illuminate the CEL if high temps are achieved.

Custom Map M will reduce WG Duty when Coolant Temp is below 60deg C and above 100deg C.
Custom Map N will reduce WG Duty when Air Temp is below 0deg C and above 50deg C.



Exhaust Gas Temp (EGT)

Just like with the Nissan GTR you can configure one of the custom map inputs for a 0 – 5v EGT sensor, this input can be configured to protect the engine should the EGT increase too high, see the GTR section for EGT sensor import configuration options.

General Tuning Tips using Custom Maps

Ignition Tuning

As RaceROM offers 3 or 4 different map switch modes you can configure different Ignition maps.

- Mode 1 could be your current ignition map.
- Mode 2 could be plus 1 deg on full load.
- Mode 3 could be plus 2 deg on full load etc.

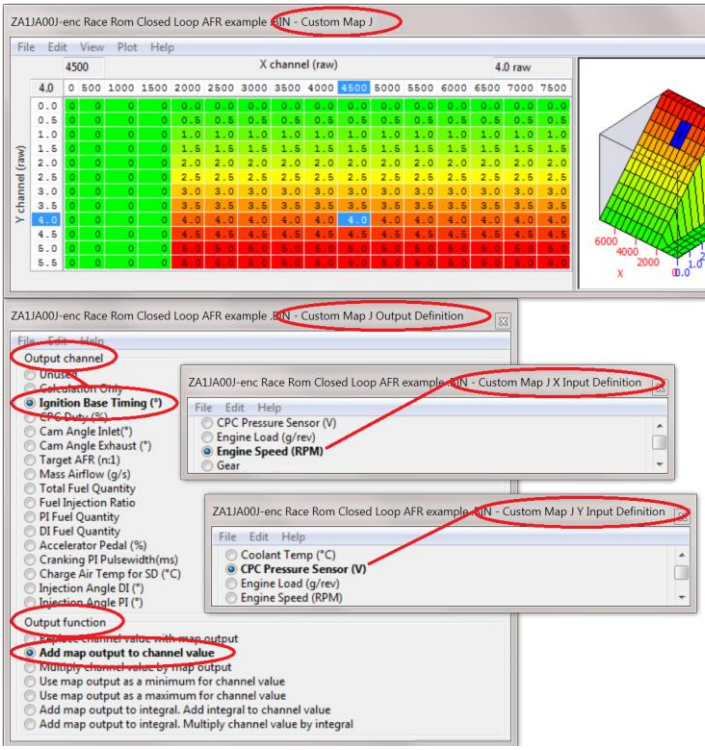
By swapping through the different modes you can quickly gauge if the engine will take more timing advance and if it makes more power without knocking.

Fuel Map Tuning

The same can be configured for the Fuel Maps, setting a different fuel map profile for each of the map switch modes.

Potentiometer Input tuning

It's possible to configure one of the ECU Inputs to adjust a Custom Map. By connecting a 0 – 5v potentiometer to the Input it's possible to 'adjust' an input up and down enabling live or real time tuning.



The X axis is RPM and the Y axis is CPC Sensor Input for the 5v potentiometer.

This example shows Custom Map J will increase (advance) the Ignition Timing dependant on the potentiometer input voltage.

At 0 volts the ignition timing will not be altered.
At 5 volts the Ignition timing will be increased by plus 5 degrees.
So the ignition can be adjusted up and down as required whilst watching power output or knock correction.

This example shows Ignition Timing but the output could be VVT angle, AFR or even DI Injection angle.

This Cosworth BRZ project development testing shows the Injection Firing Angle and Ignition Timing being adjusted simultaneously with two potentiometer voltage inputs, on the GTR there are 7 voltage inputs to play with.
This YouTube video link can be found on the EcuTek You Tube channel by searching Cosworth or follow this link to the video clip http://www.youtube.com/watch?v=bB3PDkSqNo0

The BRZ/FR-S has Dual AVCS (Intake and Exhaust Cam Timing).
We can import two 0v - 5v potentiometers and use them to adjust the Intake and Exhaust cams live and simultaneously.
By creating a log file at the same time simply lock the engine RPM on a dyno on full load then dial the two pots back and forth until the peak power output is seen, once the peak output is displayed then simply release the Accel pedal and re-apply quickly to mark the current VVT angles in the log file for map calibration later on.
Repeat this test at 250 or 500rpm intervals to build the optimum VVT map profiles.

Dash Mounted Adjustable Control

There are various high quality potentiometers available that can be dash mounted for the driver to adjust and fine tune various settings.

Here are a few suggestions:

Dash Mounted Adjustable Boost Control
This can offer the driver fully adjustable boost control, turning the Boost/WG Duty up and down as they wish.

Dash Mounted Adjustable Traction Control
This can be used as weighting factors for traction control allowing the driver to dial in more or less aggressive traction control as required.

Dash Mounted Torque Output Control
Simply turn the power up and down by acting on Torque values or Accel pedal multipliers. This can be Map Switch Mode specific and can make a simply Valet Mode.

Dash Mounted ‘Pops and Bangs’ Control
Configure a custom map to apply a heavy Ignition Retard during lift off, combined this with a rich AFR and the driver can control the intensity of the pops and bangs with the dash mounted control.

Custom Maps Summary

As can be clearly seen from this Custom Maps manual there are many possibilities for RaceROM Custom Maps.
EcuTek has pushed the boundary of the factory ECU and written features and functions that were never considered possible from the OEM ECU.
Though our competitors over time may develop similar features and produce them with slight variances on our original idea there is no doubt where the innovation originated.

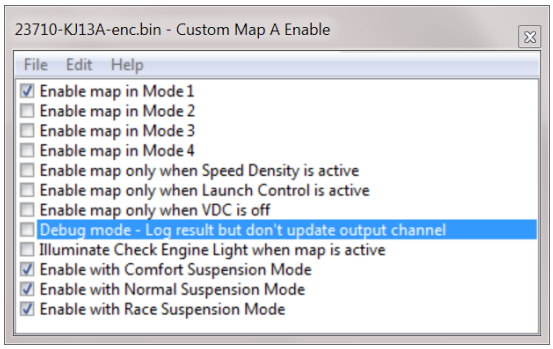
EcuTek – Innovate don’t Imitate

Frequently Asked Questions

1. Custom Map activated

Question: My Custom Map doesn't do anything?

Answer: Ensure the Custom Map is enabled for the current Map Switch Mode in the Enable Custom Maps window. In the example shown below the Custom Map will only work in Mode 1. Also ensure that the Debug box is un-checked if you want the Custom Map to work, if the Debug box is left checked then the calculation will take place and you can log the result in Live Data (Custom Map Result) but the Output Channel will not be updated.



2. The engine will not start after programming

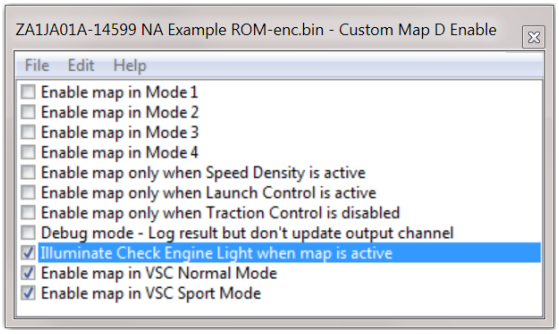
Question: After programming the ECU the vehicle will not now start.

Answer: Check your custom maps settings, if all seems OK then check the Debug box and try again, this time you can check the Result of your Custom Map in the Live Data window, see if it works as expected.

3. The check engine light comes on

Question: After programming the ECU the CEL is continuously illuminated but there are no DTCs.

Answer: Check the 'Illuminate Check Engine Light when map is active option, note that the CEL will illuminate as soon as the map is working, even if the output is not affecting any other maps, for example if the map is a boost limit for 1.6 bar and the map activation threshold is over 60 deg Coolant temp then the CEL will illuminate as soon as the coolant temp passes 60deg C.



4. Output conflict

Question: When setting multiple maps to output same channel (say ignition timing) and set output function as "replace". What will happen?

Answer: Maps are applied in alphabet order. So if A and B are both set to replace on the same channel then A will replace the original, then B will replace A.

5. Custom map activation delay

Question: There's an activation delay time map, how about deactivation delay?

Answer: Deactivation delay will be the same as activation delay. When the activation, or deactivation criteria are met, RaceROM starts a timer. If the criteria are still met when the timer exceeds the delay period then the map will be switched on or off as applicable.