

# NISTUNE

## REALTIME ECU TUNING



The screenshot displays the NISTune software interface for a Nissan VG30DET engine. It features several windows:

- Main Image:** Shows engine parameters like TP, Fuel load scale, Ign Load Scale, Fuel RPM scale, Ign RPM Scale, Min TPulse width, Max TPulse width, Fuel recover, Fuel cut, Temp Coefr, Dwell time, Dwell duty, First time enrich, After start enrich, and After idle enrich.
- Consult Log View:** A table showing engine data points for TP, RPM, MAF [LHS], Timing, and TP.
- Consult Gauges View:** A dashboard of gauges for RPM, MAF, Timing, TP, and other engine metrics.
- Map View:** A fuel map showing air-fuel ratio vs. engine speed.
- Timing Map:** A timing map showing ignition timing vs. engine speed.

## Users Manual Supplement V1.0

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# INTRODUCTION

Welcome to NIStune.

The NIStune hardware and software solution provides a means for the car enthusiast to retune their vehicle whilst retaining the factory ECU and its default programming.

This solution provides many advantages over aftermarket ECUs in that the factory default tuning is maintained once the NIStune board is installed. Upon installation of the board the vehicle will be operational as usual.

NIStune provides real-time tuning and maptracing. It provides the ability to make changes on the fly to the factory ECU and when the desired results are achieved, save these permanently in non-volatile memory on the programmable board.

Contained in this manual is supplementary information for getting started with the NIStune software.

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## Romulator Issues

*Romulator connects but fails to upload (drops out half way during upload). Similar problem also experienced when doing a 'Buffer to ROM' upload with supplied Romulator software.*

This can occur if the USB-Serial converter does not supply power/enough power to the Romulator. In most cases you should see the GREEN light on the Romulator when you plug it into the computer. You should be able to upload/download to the Romulator prior to plugging it into the ECU. This will confirm that there is enough voltage to perform operations with the ECU off

We have found that even with sufficient voltage (can upload to the Romulator prior whilst standalone) that once plugging the Romulator into the ECU, the upload fails.

During upload if it drops out, try doing the upload with the Romulators plugged into the ECU and the vehicle key set to 'IGNITION'. This will provide power to the ECU and will provide sufficient power for the romulator(s).

# 1. How do I get the ROM image out of my ECU?

When we program your NISTune board we put in what is called a 'base image'. It is the program and maps from your factory ECU that is stored in a chip.

## Type 1 Boards

It will be necessary to remove your factory ROM chip(s) and reading them using an EPROM programmer. One recommended programmer is the Willem. These can read 27C128 and 27C256 chips which are common to earlier Nissan ECUs.

The read ROM image can then be sent through to NISTune developments for programming into your NISTune Type 1 board.

*Note: Very early ECUs in the 1984-1986 era may use two ROM chips. It is highly recommended to send these type of ECUs to NISTune developments for installation*

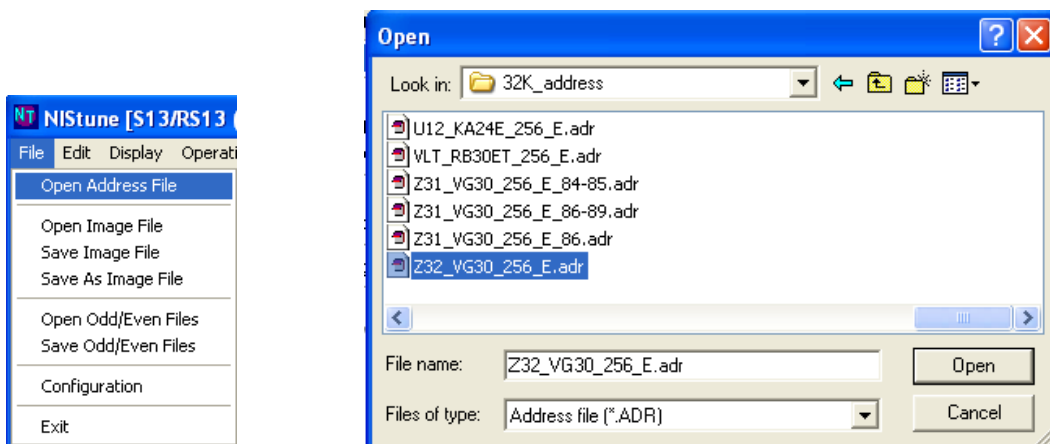
## Type 2/3/4 Boards

For most Nissan Consult capable ECUs it is possible to download the ROM image, provided you have the correct address file for it.

There are several steps involved with retrieving the ROM image out of your ECU

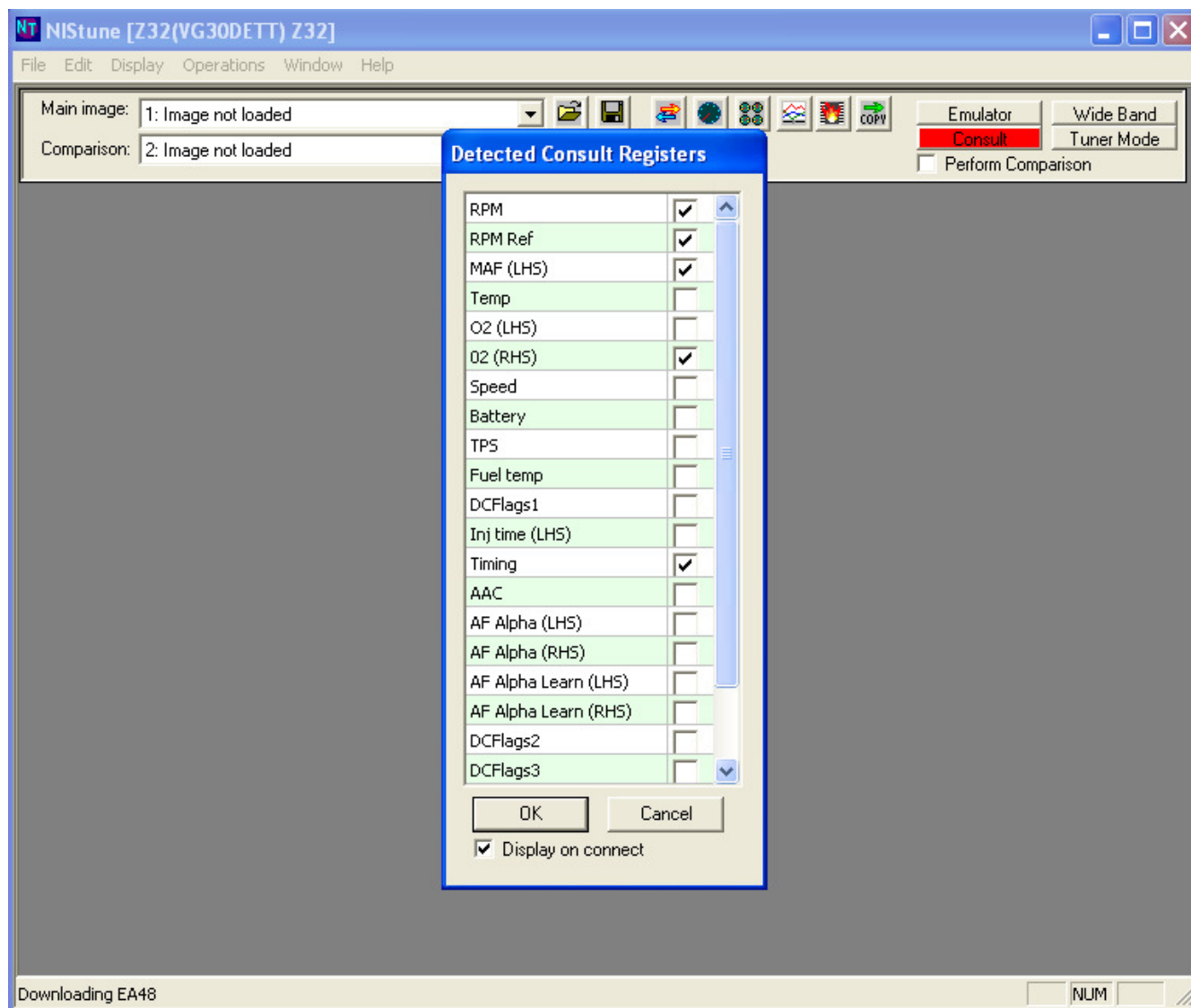
1. Load up your address file. This should have been provided with your registration email

For this example we use a Z32 300ZX address file



2. Now you will see the type of engine address file in the top title bar of NISTune.

Now on the main screen click the **Consult** button

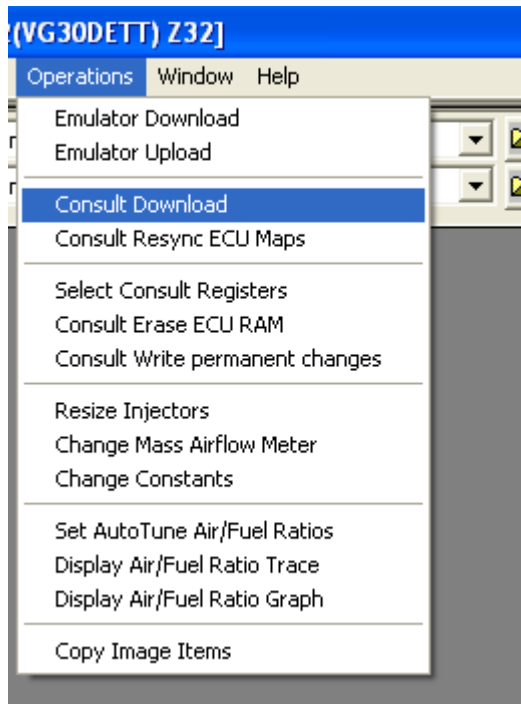


NISTune will now download the consult table specified in your address file and display all the detected consult registers on the screen.

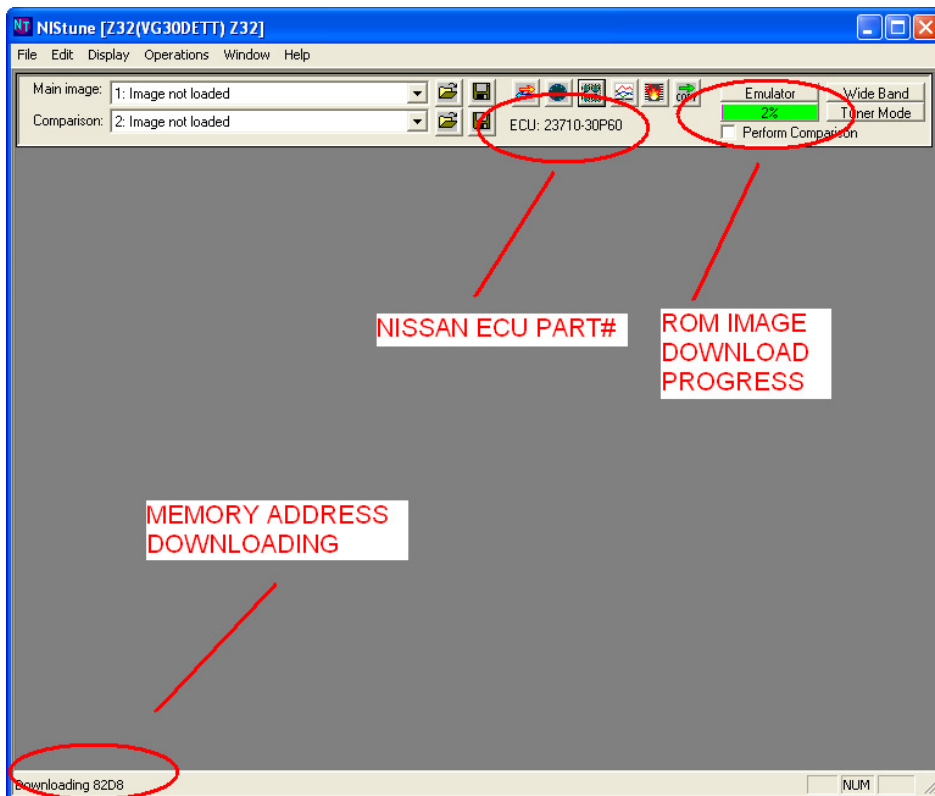
You can tick which ones you wish to view during tuning. Whilst in **Tuner Mode** the more registers you select the slower the communications will be. This is because the communications over the consult line is shared with map changes you may make. So we recommend to only select the registers that you need whilst tuning (eg RPM and TP are required for map tracing)

Click OK once you have finished. If you chose to un-tick the 'Display on connect' box this window will no longer appear next time you connect to consult. To get it back at a later time visit the menu item **Operations - Select Consult Registers**

Now to perform a download, select from the menu Operations - Consult Download



Now the Consult button will change to a progress indicator and the address being read will be displayed down the lower left hand corner of the screen.



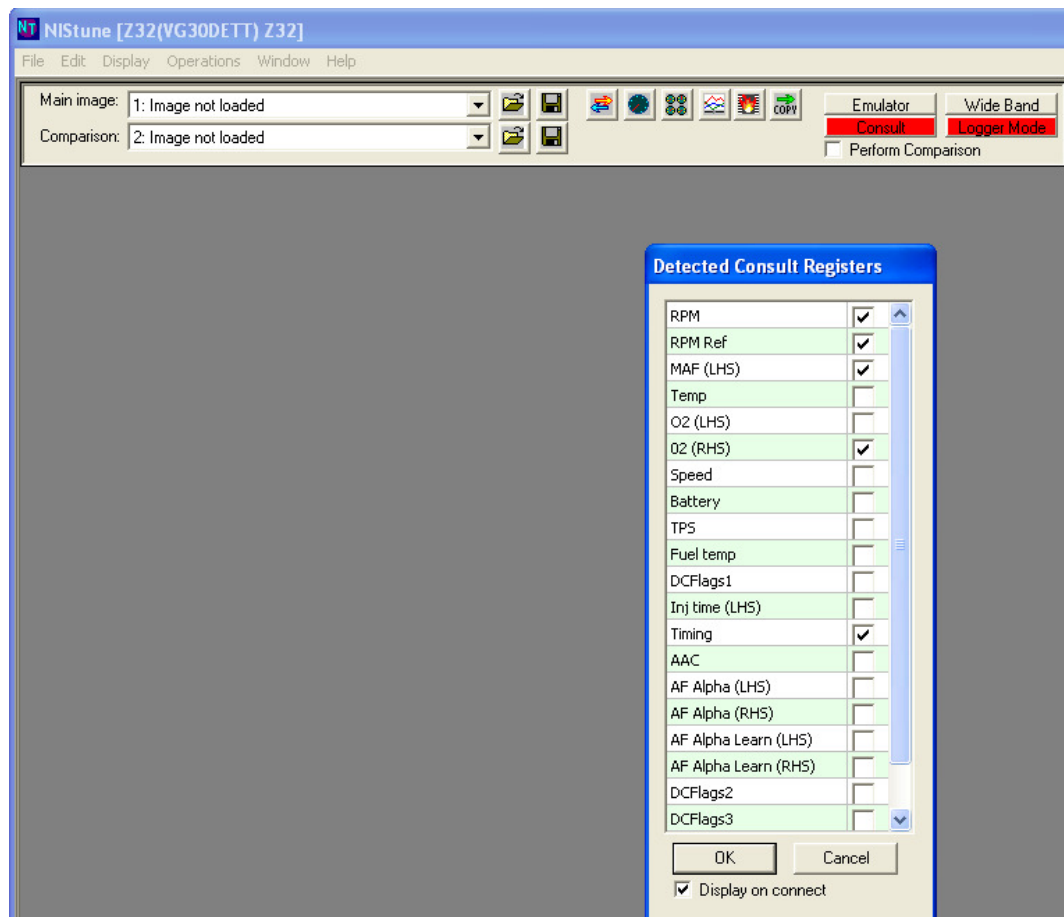
When downloading has finished, save the output file and send to NISTune developments. Use a filename descriptor such as the following:

<VEHICLE\_MODEL>\_<ENGINE>\_<PART#>\_<YEAR>\_<COUNTRY>\_<DESCRIPTOR>.BIN

For example for this file we will save as

Z32\_VG30DE\_30P60\_1990\_MAN\_FED\_T080DFM1.BIN

This allows us to catalogue your ECU ROM image easily. The ECU part # should also be stamped on your ECU casing.





## 2. What is the difference between Tuner Mode and Logger Mode?

Tuner Mode / Logger Mode is only used with Consult, Consult (Polled) and Extended Consult.

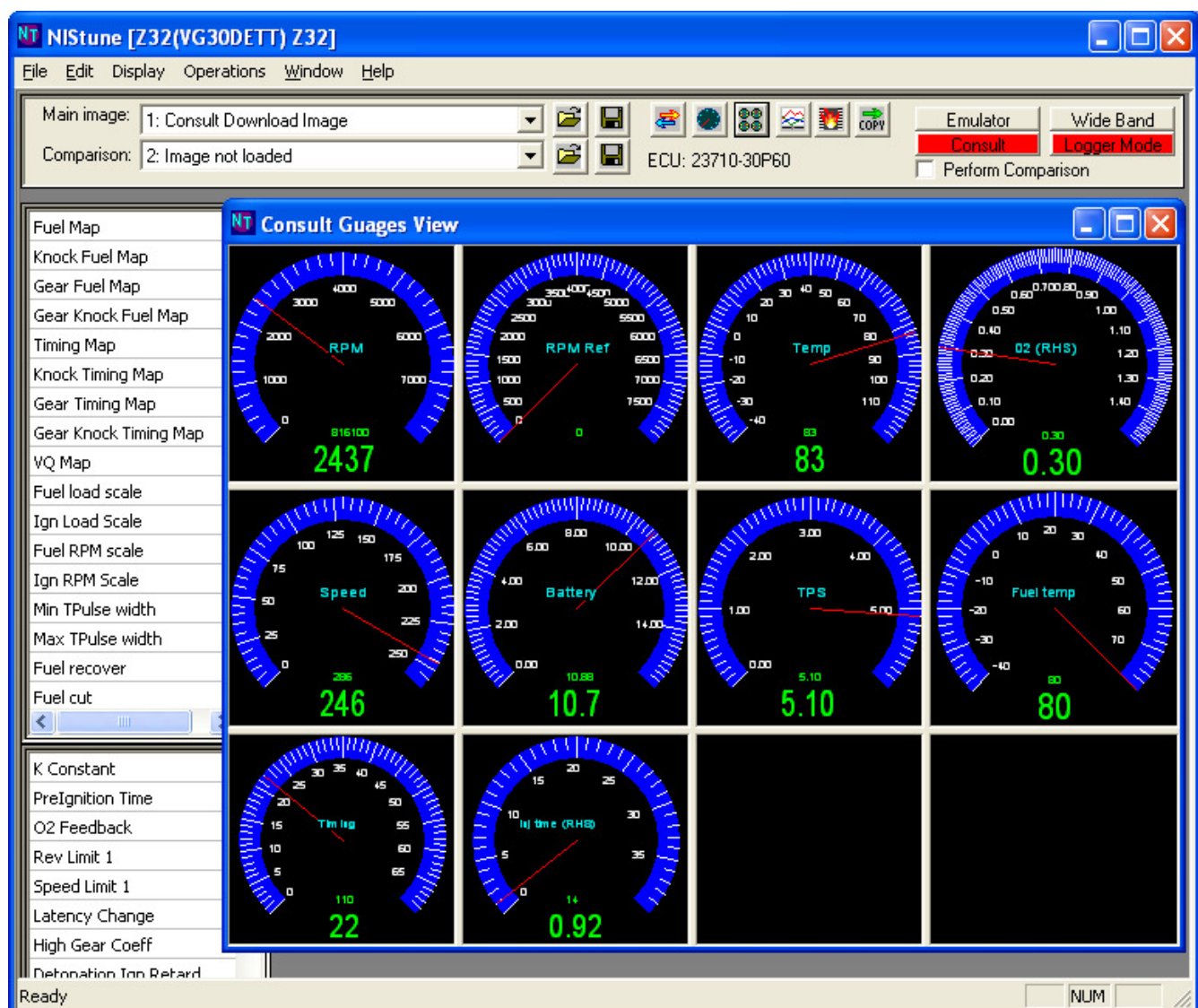
**Tuner Mode** allows you to perform real-time maptracing on an ECU where a NIStune board is not installed using TP. It is also used in Extended Consult to perform map updates to the ECU in real-time.

**Logger Mode** is the equivalent of most common Nissan Consult display tools. It provides high speed streaming of data from your ECU and is ideal for logging situations for maximum data resolution

Enable 'Logger Mode' from the main bar and then plug in your consult connection and click 'Consult'



Next clicking the Gauges icon will display all the data using quick updates of data. *Note: Real time tuning is not possible in logger mode.*



### 3. What are address (.ADR) files and how do they work?

#### Background Information

Address files came from an original Japanese freeware editing program called ROM Editor. The address files provided the capability to tell the software what to display on the screen from the ECU Rom image

A single entry from ROM Editor such as the Fuel Map location and size is in the line:

```
HIGH_FUEL, &H3D00, 16, 16, 256, 1, Fuel map
```

This tells the ROM Editor software

HIGH\_FUEL - the type of data to display in the software

&H3D00 - the ROM address location

16,16 - the map dimensions (16 x 16 bytes)

256 - the map size (256 bytes [must be a multiple of the map dimensions])

1 - the data width (1 byte wide or 2 bytes wide)

#### NISTune Implementation

NISTune reads these address files, so minimal effort is required to use existing address files that other tuners have put on the Internet. It is the most common file format for Nissan ROM editing used by tuners worldwide.

However NISTune needs some additional information to let it know more about the type of ECU you are using since there are many different model Nissans supported by the NISTune software.

The following parameters are **required**:

TYPE\_UNIT, <vehicle description>

This is just a text entry which gets displayed in the title bar of NIStune when an address file is opened. It is used for easy identification of what address file you are using at the time.

And then **either** (a) or (b) below:

**(a) Address file parameter selector type**

All address files currently known to and supplied with NIStune have a lookup index. NIStune can use internal information from the lookup index with the ECU when this value is used. When this parameter is specified, the required parameters in part b are NOT required

NTLOOKUPID=<lookup index>

**(b) Address file individual ECU parameters**

This is used to specify the parameters manually when NIStune has not yet covered an address file for a particular vehicle.

CPU=0 or 1

0 = 8 bit Hitachi CPU 6802/6303 using Type 1 / Type 2 NIStune board

1 - 16 bit Mitsubishi 7000 series using Type 3 / Type 4 NIStune board

OFFSET=&H<address>

Specifies the memory address offset that the ROM image starts at in hexadecimal. For the following ECU types:

16KB ROM (27C128) = &H8000 (ECU mirrors this at &HC000 - ROM vector table)

32KB ROM (27C256/Early 16 bit) = &H8000

64KB ROM (Late 16 bit) = &H0000

LENGTH=&H<size>

Specifies the memory address size of the ROM image in hexadecimal. For the following ECU types:

16KB ROM (27C128) = &H4000

32KB ROM (27C256/Early 16 bit) = &H8000

64KB ROM (Late 16 bit) = &H10000

CONSULT=&H<address>

Location of the Nissan consult table for register access

TPREF=&H<address>

Location of the TP reference address for register access

The following parameters are **optional**:

CYLINDER=<number of cylinders>

Typically this value is 4,6 or 8. This is used only for boost scale calculations, then the TP scale is turned off. Same as ROM Editor.

ENGINECC=<size of engine>

This value represents the cubic centimetres (or litres) of the engine. Once again this is only used for boost scale calculations (on the TP scale)

INJECTORCC=<size of current injectors>

This value represents the size of the injectors currently installed in the engine. Known factory sizes are typically used in these address files. This is used for

- (a) boost scale calculations (on the TP scale)
- (b) as the base value for the injector upgrade feature in NISTune

After changing your injector sizes, you may wish to update this value in the address file for your injectors and save the file under a different name, for example VLT\_RB30\_128\_E\_Bosh440CC\_Injectors.adr and also update the TYPE\_UNIT name

LEGACY\_AFM\_OFFSET=<millivolts>

This value is used for older type ECUs which have an offset (typically of 1500 millivolts) from the physical to received voltage of the AFM (MAF) signal. These are usually for Z31, R31, VLT and other older 1984-1989 ECUs. The offset adjusts the consult register value for MAF and affects VQ Map Tracing in NISTune.

CONSULT\_TIMING\_OFFSET=<timing offset>

This value is used to adjust the timing offset read from the ECU and reported by the timing value in consult.

TIMING\_MAP\_OFFSET=<timing offset>

This value is used to adjust the Timing map (Filtered View) on ECUs which do not represent the timing map as standard raw values. This is used for ECUs such as CA18 which have an offset of 22.

## 4. What are the supported map, table and constant parameters in NIStune?

Please also see the Mapping Guide at [www.nistune.com](http://www.nistune.com) for updated information

### Maps

HIGH\_FUEL / REG\_FUEL / UPGEAR\_HIGH\_FUEL / UPGEAR\_REG\_FUEL

#### **Maps for fuel tables (RPM vs TP vs Targeted Air Fuel Ratio)**

These maps contain the targeted Air Fuel Ratio that the ECU uses for injection. It takes the current RPM and TP values against the TP\_SCALE\_FUEL and RPM\_SCALE\_FUEL and uses the adjusted ratio to determine final injection time.

The HIGH maps are the main maps used, and REG maps are used when the ECU detects knocking. Referred to by ROM Editor as high/regular octane fuel maps.

Some vehicles such as Z32 300ZX also have UPGEAR maps in addition to the normal gear maps and are tuned separately.

Late model Nissans use the FUEL\_VE map in addition to this map (typically in the locations on this map which map to 14.7 AFR)

HIGH\_FIRE / REG\_FIRE / UPGEAR\_HIGH\_FIRE / UPGEAR\_REG\_FIRE

#### **Maps for vehicle ignition timing advance (RPM vs TP vs BDTC Timing)**

These maps contain the ignition advance to use for the given RPM vs TP values against TP\_SCALE\_FIRE and RPM\_SCALE\_FIRE

HIGH\_BOOST\_DUTY / REG\_BOOST\_DUTY

#### **Maps for boost duty cycle (RPM vs TP vs Duty Cycle)**

TBD

FUEL\_VE

#### **Map for fuel based on Volumetric Efficiency (RPM vs TP vs Duty Cycle)**

This map is used to adjust the amount of fuel +/- the targeted AFR of 14.7 the ECU should inject. It is believed this table was introduced to be used in conjunction with a vehicles MAP sensor for emissions purposes.

## Tables

TP\_SCALE\_FUEL / TP\_SCALE\_FIRE / TP\_SCALE\_BOOST\_DUTY / TP\_SCALE\_VE

### **Theoretical Pulsewidth scale for Fuel, Timing, Boost and Volumetric Efficiency maps (column index vs TP MSB value)**

Used to index fuel map columns using ECUs final calculated Theoretical Pulse width value. Adjusting this map by making TP values differ

RPM\_SCALE\_FUEL / RPM\_SCALE\_FIRE / RPM\_SCALE\_BOOST\_DUTY / RPM\_SCALE\_VE

### **RPM scale for Fuel, Timing, Boost and Volumetric Efficiency maps (row index vs RPM value)**

Used to index fuel map columns using RPMs determined from vehicles Crank Angle Sensor

TTP\_MIN / TTP\_MAX

### **Minimum and Maximum Total Theoretical Pulsewidth (RPM vs ms)**

Specifies what the limits are for injector cut off are when TP reaches these times in milliseconds. Can be adjusted for injector upgrades where the opening/closing latency characteristics of the injectors change.

AF\_LIMIT

### **Theoretical Pulsewidth Air/Fuel Injector Limiter (RPM vs TP)**

Called Air/Fuel limiter by ROM Editor, this value is actually a Theoretical Pulse width limiter. When the TP value against a certain RPM in this table is reached, the injectors are cut. This table should be adjusted when an cut has been reached after modification, but within certain limits, to still ensure safe engine operation. It is not recommended to set this table to all maximum values.

TTP\_RECOVERY

### **Total Theoretical Pulsewidth (RPM vs ms)**

When to recover and restart injection after reaching limits

FUEL\_CUT

### **Fuel Cut (Temp vs RPM)**

Specifies when to stop injecting fuel based on engine coolant temperature and RPM. When RPMs run below the numbers in this table, the injection is halted. This is used to cut fuel during deceleration.

FUEL\_RECOVER

### **Fuel Recover (Temp vs RPM)**

Specifies when to restart injecting fuel based on engine coolant temperature and RPM. When RPMs increase beyond the numbers on this table, injection continues.

ADD\_FUEL

### **Acceleration Increase Fuel (TBD)**

Increases the amount of fuel injected when quickly accelerating. Uses the TPS variable resistor to determine amount of injection.

VQ\_MAP

### **Voltage Quantifier table (mV vs Percent)**

Converts voltage from MAF which measures intake of air into a percentage. This is used by the ECU as a basis for calculating injector pulse width. This will normally get changed when a MAF conversion is performed.

TEMP\_CONV

### **Temperature conversion table (mv vs degrees C)**

Converts voltage from temperature sensor into a degrees Celsius for determining engine temperature from the water temperature sensor. Used as an input for other tables and internal calculations. This may be changed when a different temperature sensor is used, or ECU swap with a different engine.

DWELL\_TIME

### **Dwell Coil Charge time (mv vs Percent)**

Determines from battery voltage to ECU how long to charge the coil for prior to ignition

DWELL\_DUTY

### **Dwell Coil Duty Cycle time (RPM vs Percent)**

Determines from current RPMs how long to charge the coil for before igniting

AS\_ENRICH

### **After Start Enrichment Coefficient (Temp vs Percent)**

After starting the engine, determines how much extra fuel to inject when the engine is cold as a percentage.

AI\_ENRICH

### **After Idle Enrichment Coefficient (Temp vs Percent)**

When the vehicle is not idling (ie TPS is off when foot on the accelerator), determines how much extra fuel to inject when the engine is cold as a percentage.

FT\_INJECT

### **First Time Inject Enrichment Coefficient (Temp vs Percent)**

When the vehicle is first starting, determines how much fuel to inject dependent on engine temperature as a percentage.

TEMP\_ENRICH

TEMP\_ENRICH\_COLD

TEMP\_ENRICH\_FAST\_MOVE

### **Temp Enrichment Coefficient (Temp vs Percent)**

Amount of enrichment vs temperature

COLD\_START\_NEUTRAL\_MAIN

COLD\_START\_NEUTRAL\_SECONDARY

### **Cold Start Neutral Enrichment Coefficient (Temp vs Percent)**

THROTTLE\_ENRICH

THROTTLE\_ENRICH\_COLD

THROTTLE\_ENRICH\_FAST\_MOVE

### **Throttle Enrich Coefficient (Temp vs Percent)**

### **Cold Throttle Enrichment Coefficient (Temp vs Percent)**

### **Fast Movement Throttle Enrichment Coefficient (Temp vs Percent)**

COLD\_START\_TIMING\_ADVANCE  
TIMING\_ADVANCE

### **Cold Start Timing Advance (Temp vs Timing degrees)**

When the vehicle is cold, extra timing is added to the timing based on this table

CRANK\_TIMING

### **Timing Advance during engine crank (Temp vs Timing degrees)**

The amount of timing to use when engine is cranking. This is dependent on the engine coolant temperature

IDLE\_TIMING

### **Idle Timing (Temp vs Timing degrees)**

Timing Advance when the engine is idle (TPS=ON)

IDLE\_SPEED

### **Idle Speed (Temp vs RPM)**

What RPM to keep the engine at depends on coolant temperature of engine.

IDLE\_STABLIZATION\_MAX

IDLE\_STABLIZATION

Used to stabilize vehicle idling

KNOCK\_LIMIT

KNOCK\_LIMIT\_SECONDARY

Knock limit table (may be 3x3 table)



## Constants

K\_DATA

### **K Constant (Global Injection Time Multiplier)**

This value is a global adjustment for injection time. Is modified when injectors are upgraded (reduction in injector size to compensate for the amount of extra fuel injected by a larger injector) and during MAF upgrades (when the new MAF measures a greater portion of air per millivolt).

IGN\_TIME

### **14Volt Pre-ignition Injection Time Adjustment (ms)**

This is an adjustment for the amount of pre-ignition opening time to give the injector because of its opening latency. It is an adjustment against the ideal voltage of 14V. When performing injector upgrades, this value may need to be adjusted to compensate for increased/decreased opening time of the new injectors.

LATENCY\_CHANGE

VOLT\_SUPPLY\_INJ\_COEFF

VOLT\_LATENCY\_CHANGE

### **PreIgniton Injection Time Power Supply Voltage Coefficient (ms)**

This is an adjustment for the amount of pre-ignition opening time to give the injector because of deviations in voltage.

FB\_SWITCH

### **O2 Feedback Control (temp)**

The temperature at which to start using the O2 feedback sensor in the AFR table

REV1\_LIMIT / REV2\_LIMIT / REV3\_LIMIT / REV4\_LIMIT

### **RPM Limiter (RPM)**

Causes the ECU to stop injecting when RPM equals or exceeds the values specified. This is to protect the engine from damage due to valve float etc. For some engines, several stages of limiting (dependent on the time the RPM is held for) are used.

Some ECUs such as CA18 must have REV1\_LIMIT/REV3\_LIMIT equal and REV2\_LIMIT/REV4\_LIMIT equal

SPEED1\_LIMIT / SPEED2\_LIMIT / SPEED3\_LIMIT

### **Speed Limiter (km/h)**

Some vehicle markets impose speed restrictions on the vehicles. For example Japanese vehicles typically 180km/h. These are the parameters which hold those speed limits. They are in three stages, like with the RPM limiter

UPGEAR\_COEFFICIENT

### **High Gear Coefficient**

DETONATION\_IGN\_RETARD

### **Ignition Timing retard during detonation (degrees BDTC)**

How much to retard ignition timing during detonation

VTC\_TEMP\_MIN\_CUT / VTC\_TEMP\_MAX\_CUT

**Variable Cam Timing Minimum Temperature Cut (temp C)**

VTC\_SPEED\_CUT

**Variable Cam Timing Speed Cut (km/h)**

VTC\_RPM\_RECOVER

**Variable Cam Timing RPM Recover (RPM)**

VTC\_TP\_CUT

**Variable Cam Timing Theoretical Pulsewidth Cut (TP)**

## 5. Why use the consult serial port with NIStune, isn't USB faster?

USB is a time scheduled protocol which transfers data between devices using packets of data. If the packets of data are too small then the speed benefits of USB are not as great. The operating system delay between scheduled packets is one of the factors in USB speed.

USB was used on Type 1 boards where no consult capabilities were available, but this uses a special USB Consult protocol developed by NIStune developments.

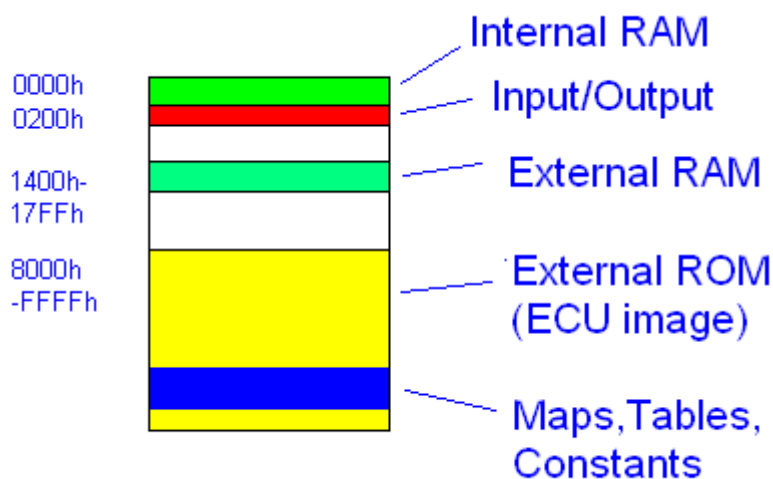
For other Type boards, during a typical map transfer sequence we will be transferring the data using 16 bytes at a time (as the ECUs do not provide much spare RAM to work with) the usage of USB is not going to provide a great benefit over 9600bps serial.

NIStune takes advantage of tuning over serial by using overlaying buffering which determines when multiple changes to the same ROM address are made, the old changes are replaced by the new changes. There is no delay in immediate tuning modifications. Resync times for all maps, tables and constants in the ROM between ECU and PC are below 15 seconds.

## 6. What do the addresses mean?

The addresses tell the ECU where the data is stored so it knows where to find information like where the consult information is located, and where maps, tables and constants are stored

Below is an example of a memory map, typical of an R32 Skyline:



Some Internal RAM and External RAM is used for holding consult data which is displayed as gauges and used for logging

The External ROM is used for program code and data (ECU image)

## 7. What parts of the NIStune board can I access?

The maps and tables are part of the ECU image (which is used by the ECU program code for execution). NIStune allows you access to the RAM and Maps, Tables and Constants areas of your ECU.

Other areas are blocked from read and write access so you cannot accidentally corrupt your ECU contents.

## 8. How does the ECU resync work?

Resync performs a data upload (from PC to ECU) or download (ECU to PC) of the ECU Maps, Tables and Constants.

When you perform a Resync to / from the ECU, the address ranges specified in the ROM Editor / NISTune address (ADR) file are either written to or read from the ECU.

Note that when you load maps from a different ECU part number for the same vehicle (or another persons tune). When you do an upload, only the maps will be uploaded, not the entire image.

Similarly, if you do not have an existing image loaded in NISTune and only perform an ECU to PC reconcile, only the maps are downloaded. If you save this as a BIN, it will be empty except for the maps saved to the file.

## 9. How do ROM images on older 8 bit 16K (27C128) ECUs work?

Older ECUs have a 64KB address space. The ROM image starts at 8000h upwards. The processor (HD6802) also needs to know where to start executing the ROM image from a vector table. This vector table is located around FF00h-FFFFh.

Since ROM chips back in the 1984 - 1986 era were small and expensive, the ECUs of this time used 8K and 1K ROM images.

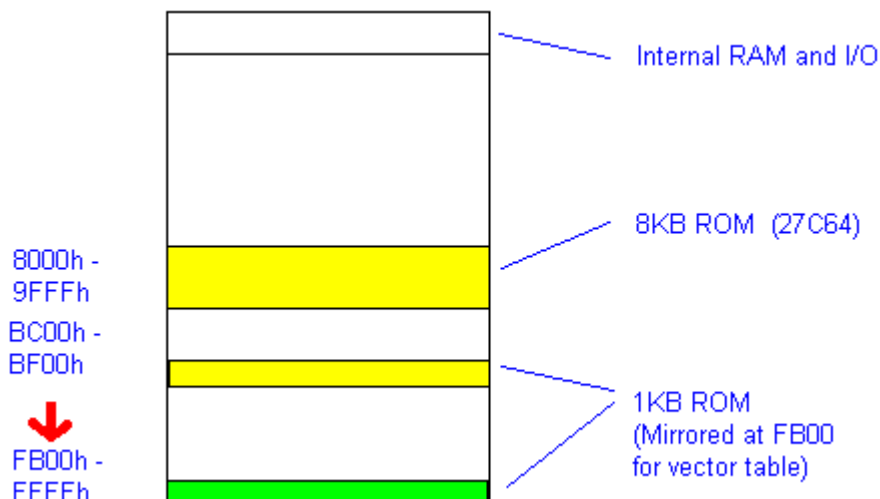
The 8K ROM image held the factory ECU code and

- two sets of TP\_SCALE
- two sets of RPM\_SCALE scalers and
- two VQ\_MAP tables.

The 1K ROM image held the rest of the maps (such as fuel and timing maps). It also held constants (single values) used by the ECU.

One of these constants tells the ECU which set of TP\_SCALE, RPM\_SCALE and VQ\_MAP to use from the first 8K ROM chip. We assume that the 8K chip was a mask programmed ROM mass produced at factory with two common configurations of scalers and VQ maps (for different MAF sensors) and that the 1K ROM chip was the tuning chip used to select which set of scalers to use and then held all the other tunable parameters.

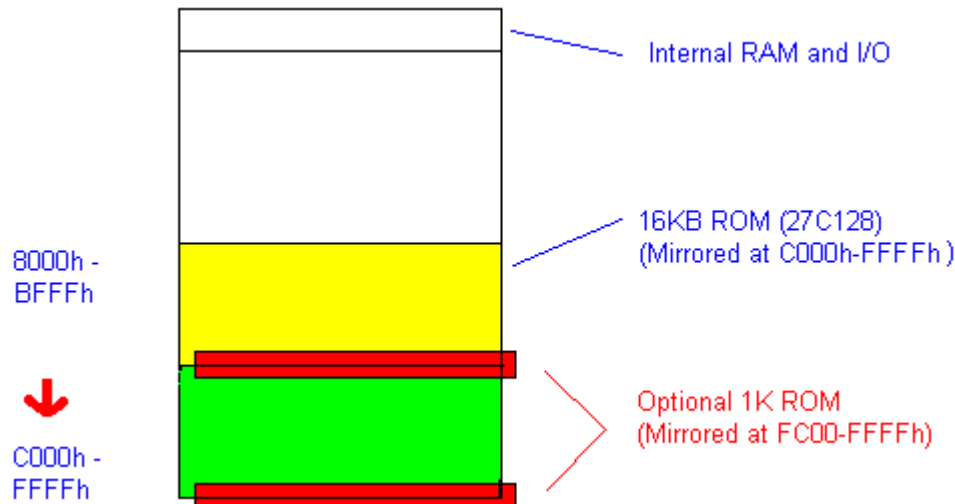
Nissan engineers put the vector table for the HD6802 at the end of the 1K ROM chip, and made this image viewable in addresses FB00h-FFFFh to it could get the vector table from there.



Reading the ROM chips from older style ECUs is a non-trivial task, which requires two separate adaptors to read each ROM chip using a standard EPROM programmer. The images must then be put into a single 16K ROM image for conversion into a NISTune 32K ENT file.

Later model ECUs from 1986 - 1990 used a 27C128 EPROM or similar 16K masked ROM chip.

Some ECUs also use an additional 1K PROM chip which over lays the tuning section of the ECU similar to the 1984-1986 ECUs. This was done for instance in some Z31 300ZX and all CR31 Skylines (in which the GMH Commodore masked ROM chip was used in all ECUs but then a CR31 Skyline specific PROM chip was added to change the fuel maps and add the fuel pump diagnostic code)



When programming a factory ROM image into an EPROM, you can

- (a) program the 16K directly into a 27C128 EPROM (addresses 0x0000-0x3FFF on the chip) or
- (b) program the top 16K of a 27C256 EPROM (addresses 0x4000-0x7FFF on the chip)

The 27C256 chip is compatible and cheaper than the 27C128 chip. Since the extra address line (A14) connects to a VCC line in this ECU, the top 16K is selected. When reading back a chip with this address, you must only read addresses 0x4000-0x7FFF in your EPROM programmer and save as a 16KB file.

When using 16KB files with NISTune, ensure that you load the matching address file from the ECU from the 16K\_address directory (the file name must be a 128 kbit file)

## REVISION HISTORY

<b>DATE</b>	<b>VERSION</b>	<b>DESCRIPTION</b>	<b>AUTHOR</b>
24MAY09	1.0	Moved from Software Users Manual	MB
28MAR12	1.1	Formatting updates	MB

## TERMS AND CONDITIONS

Nistune Developments has performed necessary measures to ensure that the Nistune software and boards are built to high standards. By using this product you agree to the following terms:

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