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AEMPro Users Guide

Version 1.16.2a

Introduction

Congratulations! You have just purchased the AEM Programmable Engine Management System (AEM EMS), one of the finest programmable engine management systems on the market.

To ensure proper use of this system and to prevent risk of damage to your vehicle, you must read these instructions and understand them thoroughly before attempting to program this unit.

Note: Use the Bookmarks function to make navigating the User Guide easier.

The AEM EMS

The AEM Programmable Engine Management System (AEM EMS) is a Windows™ based, user-programmable, Electronic Control Unit (ECU) that uses a powerful 16/32 Motorola bit3 microprocessor and has 512k of memory for data storage. On most applications, the AEM EMS is a “plug and play” (PNP) installation using the vehicle manufacturer’s Original Equipment (OE) connectors, wiring and sensors, eliminating the need for expensive custom built wire harnessing and non-stock sensors.

The AEM Engine Management System includes a configurable, internal, data logger capable of recording over twenty minutes of information. Every AEM Engine Management System comes with all functions installed and activated, and there are no expensive options or upgrades to be performed.

If you do not have a comprehensive understanding of stand alone engine management systems, please read the AEM Basics manual (AEM Basics.pdf) found in the AEM program directory or the supplied CD-ROM before proceeding. It is a very good overview of engine management technology and addresses important areas that must be understood by the tuner if a successful installation is to be performed.

Next, you **must** read the glossary. This is the key to understanding the system; it gives an explanation of each available parameter, it’s configuration and what it controls. The answer to most questions can be found by referring to the glossary.

Check the Package Contents

After you receive your AEM EMS it is important to inspect the contents of the box to ensure all required equipment is received and in good condition.

The following is a list of items shipped with each AEM EMS.

- ECU
- Software CD-ROM
- RS232 Communication Cable 6ft.
- Copy of Warning information
- Strip of Velcro (used for mounting EMS)
- Accessory Connector (where applicable)
- Connector pins (where applicable)
- AEM decal

Software

System Requirements

The following describes the minimum recommended specifications to successfully run the AEM EMS software.

- Windows™ 95 or higher operating system
- 233 Mhz Pentium™ or compatible processor
- 256 Color, 800x600 minimum resolution Video screen
- CD-ROM Drive
- 9-pin RS-232 Serial Communications Port (Communication problems may be encountered if using a USB>RS232 Adapter)
- 64 Mb of RAM (random access memory), 256 recommended.

⇒ The more RAM you have, the more efficiently AEM Pro and AEM Log will run, particularly when using the real-time tuning and PC logging features.

AEMPro CD Contents

This CD contains:

- AEMPro Software
- AEMLog Software
- AEM Quick Start Guide
- AEM EFI Basics Manual (AEM Basics.pdf)
- AEMPro Users Manual (AEMPro User Guide)
- AEMLog Users Manual (AEMLog Users Manual)
- AEM EMS mounting instructions (AEM Mounting Instructions)
- EMS Installation instructions and ECU Locator
- Adobe Reader installation software
- Calibration files for developed vehicle configurations (AEM Calibration File Access)
- Available Output pins for unused pin locations on PNP applications
- Unit Conversion software (Convert.exe)
- Excel spreadsheet for spark tooth calculations

All appropriate reference material will be available by accessing the AEM Software CD

Installing the AEMPro and AEMLog Software

- ⇒ It is strongly recommended that you close all the programs and toolbars on your Windows taskbar before inserting the AEM software CD-ROM.
- ⇒ Ensure the laptop computer's battery is fully charged or plugged into an AC or DC power source before proceeding with the installation.

How to Install

- Insert the AEM CD into the CD-ROM drive of your computer
- The CD will auto run to install the AEMPro and AEMLog software
- An install dialog box will be displayed with options such as view user manuals, install AEM software, install Adobe Reader, etc
- We strongly recommend reading the supplied user manuals before beginning installation
- If the auto run feature is disabled on the PC, use the following steps to begin
 - Double click on the My Computer Icon | CD-ROM Drive | AEMReleaseXXXX.exe (where XXXX=latest version)
- Select Install AEMPro software
- Follow the instructions on the screen to complete installation
- It is recommended to leave the default target installation directory (c:/Program Files/AEM) unchanged, this will simplify future updates
- Restart the PC

Get Up to Date

After installing the AEMPro software it is important to go to the AEM Forum website at www.aempower.com/bbs and register your EMS. Doing so will allow you access to the most current information, calibrations and updates. We are continually updating the software to add features as well as resolve issues discovered in the field.

How to Register

Go to www.aempower.com/bbs then click on *Register*, read the User Agreement then click on Agree. This will take you to the Registration Information Page. Input all applicable user information.

To access the AEM Software updates, it is **mandatory to input the correct serial number format** for the **Registration** field. This number format is explained with an example above the **Registration** field.

Determining the Version

To determine if the installed software is the most current version available, use the following steps

- Open AEMPro program by using the *AEMPro icon* on the Windows desktop, then click on the *Help* dropdown menu then *about*, the software version will be displayed in the *About AEMPro* window, compare this number to the information on the AEM Forum Web Site.
- It is important to also note the version of the Model Specific Calibration file (.gdf) to be used. The file can be found by navigating to the AEMPro directory (C:\Program Files\AEM\AEMPro) and looking at the Calibration file name. The 12 characters after the name designate the version (xxnamexx.AEM15GEN.V0.73.gdf). Compare installed version with the information posted on AEM Forum.

Installing the updated files

When updated software is available the following steps describe how to install the updates.

ECU Strategy Updates

- Download the updated files by selecting the link from the AEM Forum Web Site
 - Save the file to a folder on the PC hard drive that is easily found after the download is complete
- Using Windows Explorer navigate to the folder where the updated file was saved and double click on the downloaded file
- Follow the on-screen instructions, same as original installation
- There are 2 files associated with each strategy level
 - *.*FIN* is the firmware and is uploaded into the EMS and should be stored in the AEM/AEMPro/*FIN* directory
 - *.*GIN* is the definitions file, which allows AEMPro to recognize the specific file format and should be stored in the AEM/AEMPro/*GIN* directory
- After update is complete, the files then need to "install" into AEMPro
- Installation of the new configuration software follows these steps
 - Start AEMPro | Select *ECU* | *Install ECU...* | Select *Add*
 - Navigate to the updated configuration (.gin) file that needs to be loaded
 - Select the updated configuration file from the window and select the *Open* button
- The name and version of the configuration file supported is displayed in the New ECU Group Box. If the selected file is not a valid Configuration File a message box appears stating 'Bad Initialization file'
- Press the Yes Button in the Confirm Box to install the Configuration File. The updated ECU name and version is added to the list contained in the Installed ECU's Group Box
- It is possible to verify the installation of the ECU was completed successfully by the following procedure
 - Select *ECU* | *Install ECU...* from the menu
 - The ECU Installation window appears
 - Press the *Verify* Button within the Installed ECU's Group Box
 - If all installations are valid, a message box appears stating '*All installations are valid*'. If an installation is not valid a message box appears stating '*the file XXXX does not exist. Remove reference?*' where XXXX is the name of the missing configuration file. If you wish to remove this reference from the list of installed ECU's click on the *Yes* Button, otherwise click on the *No* Button. Any further references, which do not exist, will also be shown
 - Finally a message box appears stating 'All installations are valid'

Firmware Updates (.fin)

The Firmware updates (.fin) files will be uploaded directly into the ECU, if communication issues between the ECU and PC arise refer to **ECU Communications** later in this Guide. The following steps describe how to load this file.

- ⇒ The updated .fin file will be copied to the c:/program files/AEM/AEMPro/Fin directory when the Strategy update is carried out
- Start AEMPro software | *ECU* | *In System Programming...* | *Fin* folder | *Open* | updated .fin file (highest value last digits) | *Open*. Progress bar shows upload status

WARNING:

Do not interrupt the Firmware update process. This could result in a loss of communication with the EMS

Model Specific Calibration (.gdf) Files

Updated Model Specific Calibration files are made available as more information and testing is carried out by AEM Engineers. These files are made available through the AEM Forum at www.aempower.com/bbs under the Model Specific headings | Calibrations

- ⇒ It is important to install the AEMPro.exe software update, as outlined above, before attempting to upload the updated Model Specific (.gdf) Calibration file.
- Download updated Calibration (.gdf) file for the appropriate vehicle model and configuration, save it to the *c:/program files/AEM/AEMPro* directory
- Install the updated Calibration (.gdf) file using the following procedure
 - Start the AEMPro software | *ECU* | *Upload* | choose the updated Calibration (.gdf) | *Open*

Communication

Introduction

To communicate with the ECU the PC or Laptop must be connected via the supplied serial cable. One end must be connected to a 9pin PC RS-232 port (COM1, 2, 3...10) of the PC and the other to the ECU

Serial Port

The default serial port for communication with an ECU is COM1

- ⇒ **It is important that the correct COM port to be used is set in the PC software, or no communication will occur**

To change the COM port the AEMPro will use, select *ECU* | *Port...* from the menu in AEMPro, followed by the appropriate port. The available options are currently COM1 through COM10

To determine which COM ports are available on your PC follow these instructions:

- Select *Start* | *Settings* | *Control Panel*
- Double click on *System*
- Select the *Device Manager* tab
- Open the *Ports* entry by clicking on the plus sign next to it

The different COM ports available on the PC will be displayed stating their type

It is very important that the PC port selection and the port selection in the AEMPro software agree

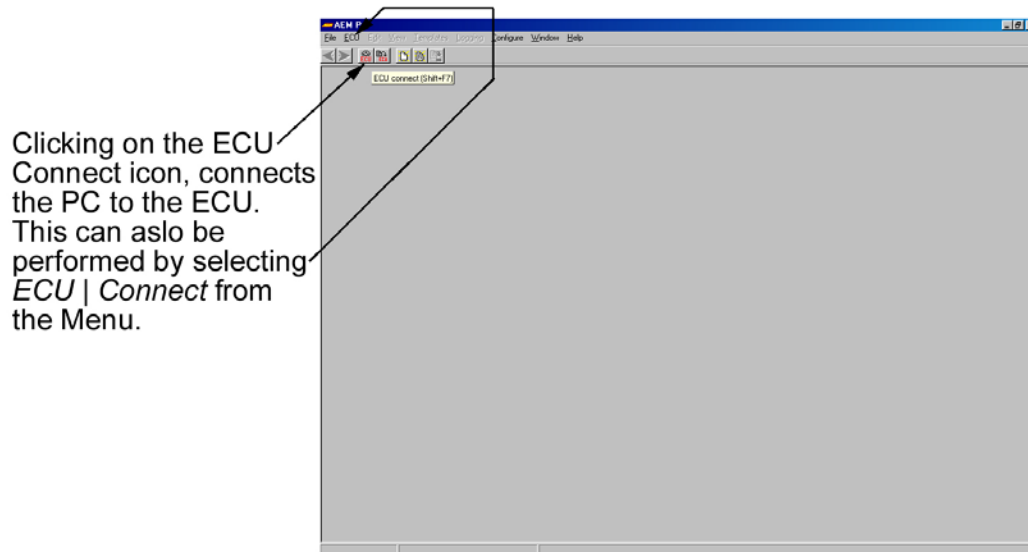
- ⇒ **If the COM port is not correctly set, any attempts to connect to the ECU will result in failure**

Communicating with the ECU

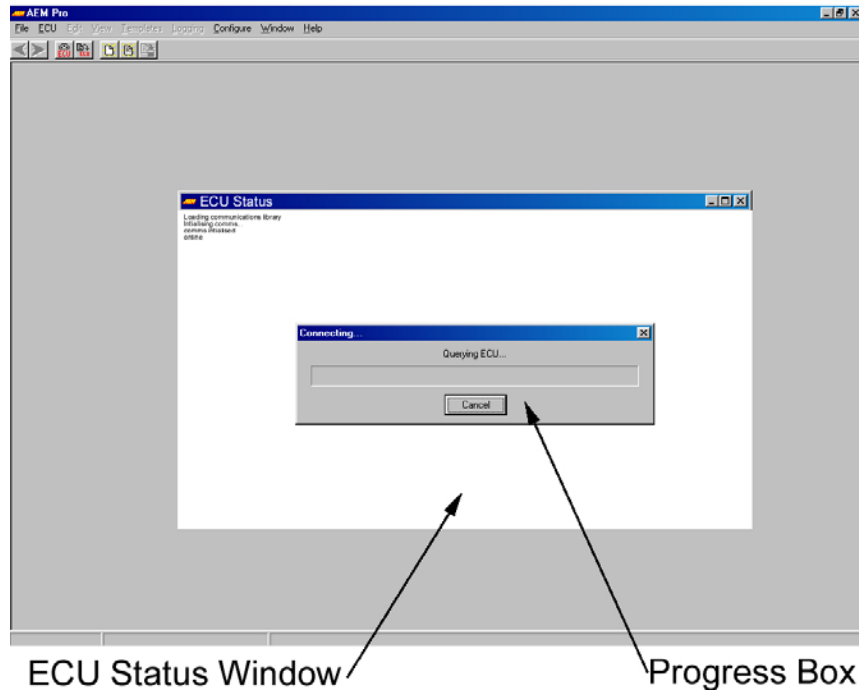
When AEMPro attempts to connect to the AEM EMS for any reason, the *ECU Status Window* and a *Progress Box* will appear while AEMPro attempts to discover the ECU's configuration. It will then download the current calibration that is programmed into the ECU to the Laptop. If there is no calibration loaded into the ECU, one will need to be uploaded

Connecting with an ECU

To connect with the AEM EMS, click on the *Connect ECU Icon*, select the *ECU | Connect*, or <shift> + F7
See Figure 1



Connecting with an ECU



ECU Status Window and Progress Box

Problems Encountered Communicating with the ECU

Most problems that are likely to be encountered are covered by the previous headings. If the *ECU Status Window* and *Progress Box* appear but the progress box fails to fill, check the following possible faults

- Verify connection of the COM cable between the ECU and the PC
- Verify that the correct COM port is selected in AEMPro
- Verify that the ECU has power
 - ⇒ Check the ECU fuse (located in the cars fuse panel) to make sure it is in working condition
- Verify that no other programs are using the COM port. **Note:** Some PCMCIA cards will disable COM 1 as a serial port connection when installed. DOS windows that have previously used the selected COM port must be closed in order to shut the COM port completely
- If the *ECU Status Window* displays the message '*ECU Type Not Found*' – the connected ECU does not have the appropriate software installed. (See *Installing the ECU Configuration Software*)
- If the *ECU Status Window* displays the message '*Cannot open COM port*' – the COM port is already open by another application, does not exist or is incompatible (See *Serial Port*)
 - ⇒ Check for multiple sessions of AEMPro being open

Installing the ECU Configuration Software

Without the correct ECU configuration software, AEMPro will not be able to communicate with ECU. The installation disk will automatically install the appropriate configuration software when initially configured. See <http://www.aempower.com/bbs> for any updates.

To install a new vehicle configuration software follow these steps:

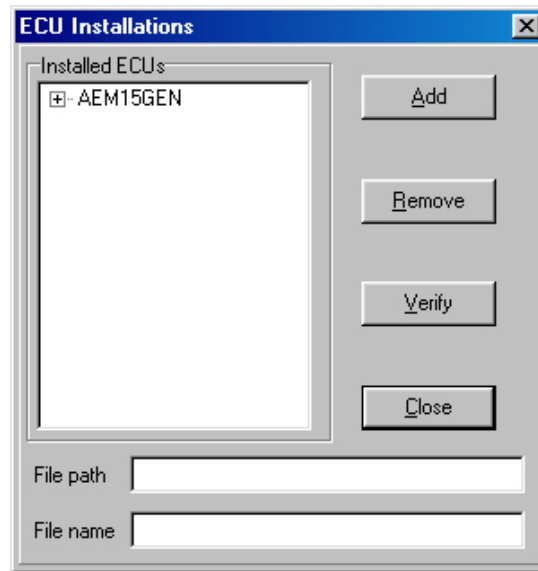
- Select *ECU | Install ECU...*
- Select *Add*.
- Navigate to the configuration file that needs to be loaded (*.gin*) file.
 - The file that is to be loaded must agree with the firmware version you intend to run.
- Select the required configuration file from the *Open Window* and press the *Open Button*.

The *Open Window* disappears. The name and version of the configuration file supported is displayed in the *New ECU Group Box*. If the selected file is not a valid configuration file a message box appears stating '*Bad Initialisation File*'.

- Press the *Yes Button* in the *Confirm Box* to install the configuration file.

The ECU name and version is added to the list contained in the *Installed ECU's Group Box*.

Illustration shows The *ECU Installations Window*. Any current installations of configuration files can be viewed by clicking on the (+).



ECU Installations Window

Verifying ECU Initialisation Files

If there are problems communicating with the ECU, and you believe the correct configuration file is installed, the configuration file can be verified.

- Select *ECU | Install...* from the menu.

The *ECU Installations Window* appears (see figure 3). This shows all ECU types and versions currently installed, and allows installation and verification of configuration files.

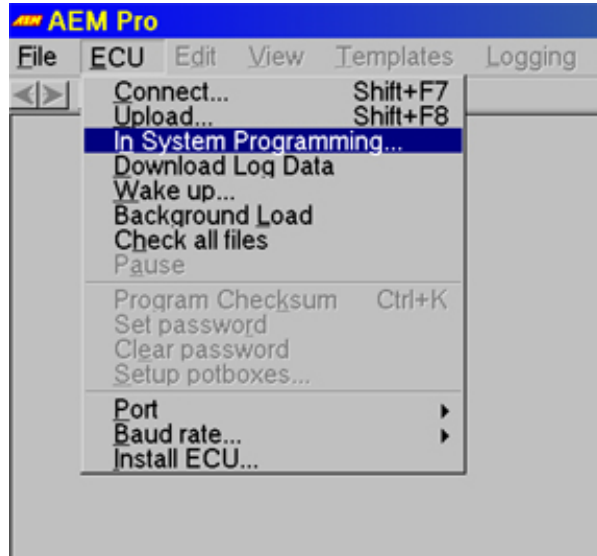
- Press the *Verify Button* within the *Installed ECU's Group Box*.

If all installations are valid a message box appears stating '*All installations are valid*'. If any installation is not valid a message box appears stating, '*The file XXXX does not exist. Remove reference?*' where XXXX is the name of the missing configuration file. If you wish to remove this reference from the list of installed ECU's click on the *Yes Button* otherwise click on the *No Button*. Any further references, which do not exist, will also be displayed.

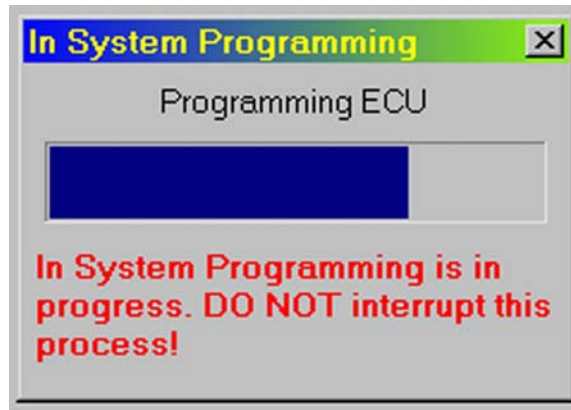
Updating the AEM ECU with New Firmware

AEM is continuously adding and improving features of the AEM EMS system. The file that controls the interaction of the ECU and the calibration software is called firmware. This firmware can be changed by the tuner using our *In System Programming* feature. The latest updates to the firmware can be found on the AEM Forum website <http://www.aempower.com/bbs>. The firmware may contain features that were not available in earlier versions. In many cases this is not needed and the version of the ECU you currently have in use will be sufficient. The file type for firmware is (.fin).

To update the firmware, download the *fin* file from our Internet site, save the file to the fin file folder and save to that location. Once this is done, open AEMPro and select ECU from the menu bar at the top of the screen. Go to *In System Programming*; navigate to the fin file folder, select the downloaded file. Click on open and let the program run. **DO NOT INTERRUPT THIS PROCESS!** The computer will inform you that the in system programming is complete and click on the *Ok Button* at the prompt. The ECU now has the updated firmware. In order to use this firmware a matching configuration (.gin) file has to be installed as described in the *Installing ECU configuration Software* preceding this section.

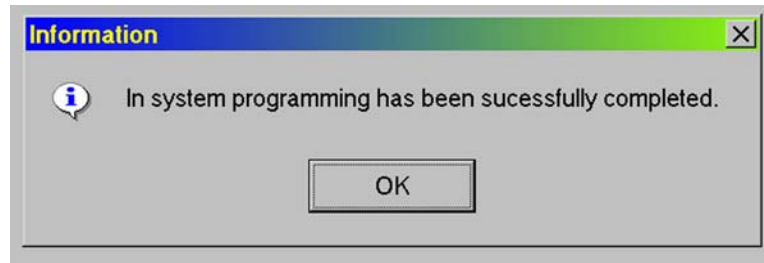


In System Programming Setup



In System Programming Window

Illustration shows *In system programming* in process. **Do NOT interrupt this process.** If you interrupt this process the ECU may have to be sent back to AEM for resetting the ECU program.



In System Programming Complete Window

Illustration shows *In system programming* complete. Click the *OK Button*.

The Active ECU File

When working *Online*, a copy of the ECU's calibration is held in a file called the *Workmap File*. AEMPro changes this file automatically as necessary. For example, if any part of the ECU calibration is changed the same change is effected in the *Workmap File*. Also when uploading or downloading a file the *Workmap File* will be changed to the calibration held in the ECU. While working *Online* it is not possible to view or edit any other file. However, the *Workmap File* can be saved as a different calibration name. The most useful function this has is that you can always revert back to the ECU's last state of configuration *Offline*, by opening the *Workmap File*. This helps avoid losing data, even if you forget to save your changes.

Note: When making changes *Offline*, save the file under a new name. Do not use the *Workmap File* as a name to save the calibration. This file is over written when connecting to the ECU.

Online Calibrations

Connecting to the ECU / Downloading a Calibration

In AEM terms, downloading means reading data from the ECU to the PC. Connecting to an ECU will make AEMPro obtain a copy of the calibration held in the ECU. To connect to an ECU use any one of the following options.

- Select *ECU | Connect...* from the menu.
- Press <Shift> + F7.
- Click on the download button.




By selecting connect to ECU, any open calibration is closed, and any live connection is terminated. AEMPro then queries the connected ECU to determine its' type (see *Communicating with an ECU*). By default, AEMPro then downloads the calibration from the ECU. If the calibration is different than the *Active ECU File* another progress box appears as it downloads the calibration.

The calibration is then saved as the *Active ECU File* (see *The Active ECU file*). Finally the *ECU Status Window* appears and the last displayed template is loaded (see *Templates and Background Loading*).

Uploading a Calibration

Uploading means writing data from the PC to the ECU. To upload a calibration, use any of the following options.

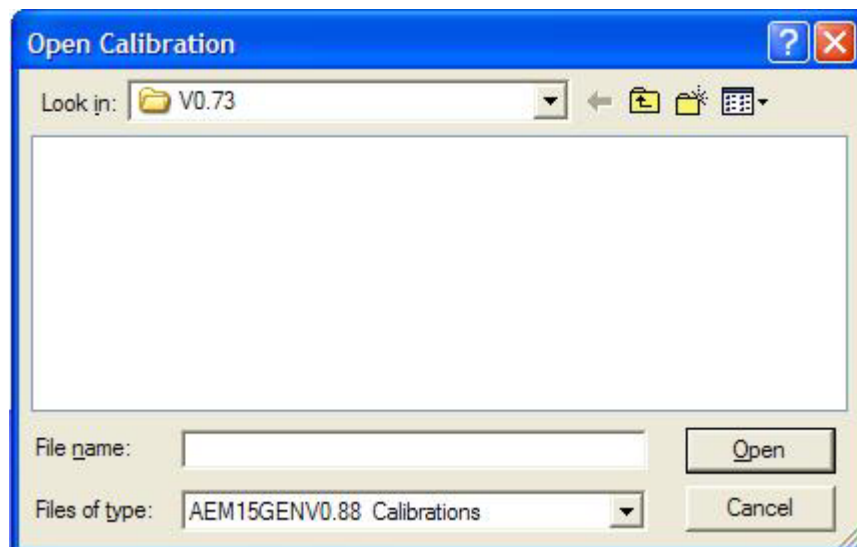
- Select *ECU | Upload...* from the menu.
- Press <Shift> + F8.
- Click on the upload button. 

By selecting connect ECU, any open calibration is closed, and any live connection is terminated. AEMPro queries the connected ECU to determine its' type (see *Communicating with an ECU*). Once the ECU type is determined the *Open Calibration Window* appears.

The *Open Calibration Window* shows the ECU type and a list of valid calibrations (if any exist).

To upload the selected calibration, press the *Open Button*, or double click on the calibration name. The *Open Calibration Window* disappears, and another *Progress Window* appears as it uploads the calibration. The calibration is then saved as the *Active ECU File* (see *Active ECU File*). Finally the *ECU Status Window* appears and the last template displayed is loaded (see *Templates*). To cancel the upload, press the *Cancel Button*.

If engine is running, AEMPro will not upload the calibration.




Upload Window

Offline Calibrations

Opening a Calibration File

To open an existing calibration for viewing or editing *Offline* use any of the following options.

- Select *File | Open...* from the menu.
- Press the F3 button.
- Click on the open button. 

If a file is currently open, it is closed if *Online* the connection is terminated. The *Open Calibration Window* (see Figure 8) appears showing files for the currently selected ECU type.


The ECU type can be changed to any installed type by selecting it from the pull-down list box.

To open the selected calibration, press the *Open Button*. The calibration is opened and the template for the last known state is loaded (see *Templates*).

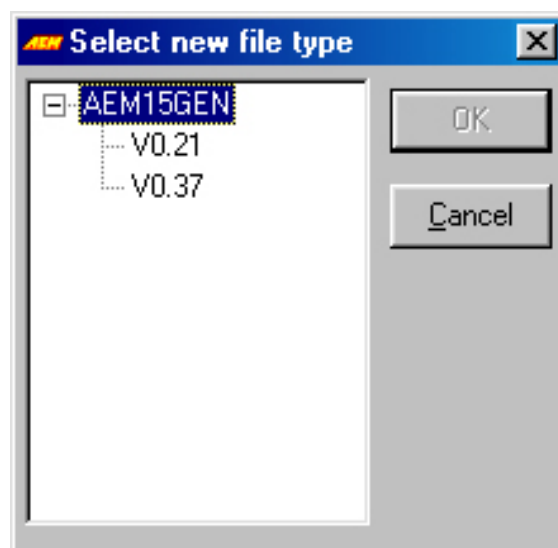
To cancel the opening of a calibration, press the *Cancel Button*.

Creating a New Calibration File

To create a new calibration file use any of the following options.

- Select *File | New...* from the menu.
- Press the F4 button.
- Click on the new calibration button. 

If a file is currently open, it is closed or if *Online* the connection is terminated. The *New File Window* appears showing the ECU types available for which a new calibration can be made.



New File Window


To create a new calibration of the selected ECU Type, press the *Ok Button*. A new calibration is created and the template for the last known state is loaded (see *Templates*).

To cancel the creation of a new calibration, press the *Cancel Button*.

Saving a Calibration File

If a file is open it can be saved as its' current file name or saved as a different file name.

To save the calibration as the current file name use any of the following options.

- Select *File | Save* from the menu.
- Press F2.
- Click on the *Save Button*. 

The calibration is saved to the current File name. If *Online* this will be the *Active ECU File*.

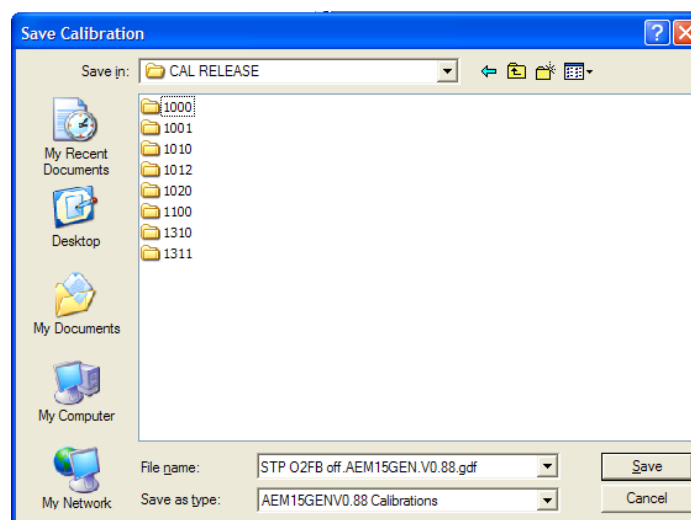
To save the calibration to a different file name use the following operation.

- Select *File | Save As...* from the menu.

A specific file name can be typed into the File name box

To save the calibration to that in the name box, press the *Save Button*. If a file with that name already exists a prompt appears asking whether to overwrite the existing calibration. To overwrite the calibration press the *Yes Button*, to choose another name press the *No Button* and enter the name of the calibration.

To cancel the save, press the *Cancel Button*.



Save as Window

Comparing Calibrations

Two calibrations can be compared to discover any differences between them. To compare files use the following operation.

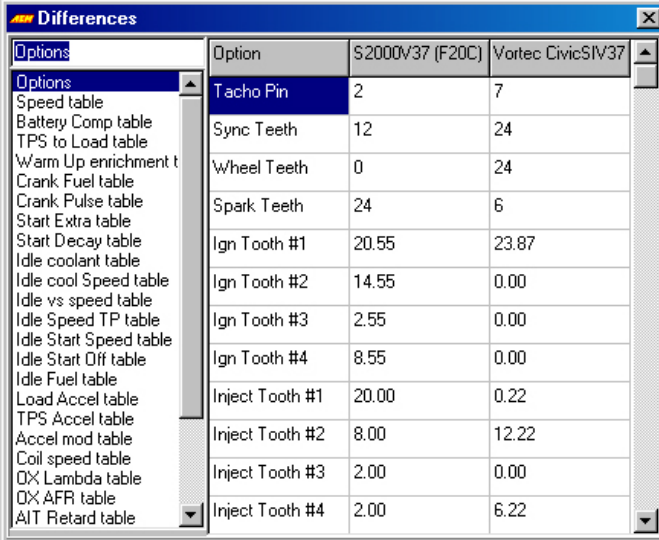
- Open one of the calibration files to be compared.
- Select *File | Compare...* from the menu.

The *Compare Window* appears showing all calibrations to which the open calibration can be compared.

To compare the two files press the *Open Button*. If no differences are encountered this is stated in a message box. If there are differences the *Difference Window* appears.

The *Difference Window* (see figure 11) shows the name of all areas of the calibration that have differences on the left. Highlighting the name of an area causes the details of the differences to be displayed in the grid on the right. This shows the exact location of each difference and the value of each calibration at that location.

To cancel the comparison, press the *Cancel Button*.



Options	Option	S2000V37 (F20C)	Vortec CivicSIV37
Options	Tacho Pin	2	7
Speed table	Sync Teeth	12	24
Battery Comp table	Wheel Teeth	0	24
TPS to Load table	Spark Teeth	24	6
Warm Up enrichment t	Ign Tooth #1	20.55	23.87
Crank Fuel table	Ign Tooth #2	14.55	0.00
Crank Pulse table	Ign Tooth #3	2.55	0.00
Start Extra table	Ign Tooth #4	8.55	0.00
Start Decay table	Inject Tooth #1	20.00	0.22
Idle coolant table	Inject Tooth #2	8.00	12.22
Idle cool Speed table	Inject Tooth #3	2.00	0.00
Idle vs speed table	Inject Tooth #4	2.00	6.22
Idle Speed TP table			
Idle Start Speed table			
Idle Start Off table			
Idle Fuel table			
Load Accel table			
TPS Accel table			
Accel mod table			
Coil speed table			
OX Lambda table			
OX AFR table			
AIT Retard table			

Difference Window

To close the *Difference Window* press the *Close Button (X)*

Converting Calibration Files for Different ECU Types

This feature will typically only be used if AEM has an updated firmware version available for your particular ECU. This allows the previous calibration map to be converted to the new firmware version.

To convert a calibration file to another ECU type use the following operation.

- Select *File | Convert...* from the menu.

The *Converter Window* (see figure 12) appears in the background and the *Open Window* appears showing files for the currently selected ECU type.

The ECU type can be changed to any installed type by selecting it from the pull-down list box. If the ECU type is changed, the list of calibration files changes to the selected ECU type. Highlighting a calibration name causes the notes of that calibration to be displayed in the text box on the right (if any exist).

To cancel the conversion of a calibration, press the *Cancel Button*.

To open the selected calibration, press the *Open Button*. The *Conversion Window* appears showing all installed ECU types to which the calibration can be converted. Highlight the ECU type to which the calibration is to be converted.

To begin conversion of the calibration, press the *OK Button*. AEMPro attempts to convert every option, table and map contained in the open calibration's file to a respective option, table or map in the converted calibration's file.

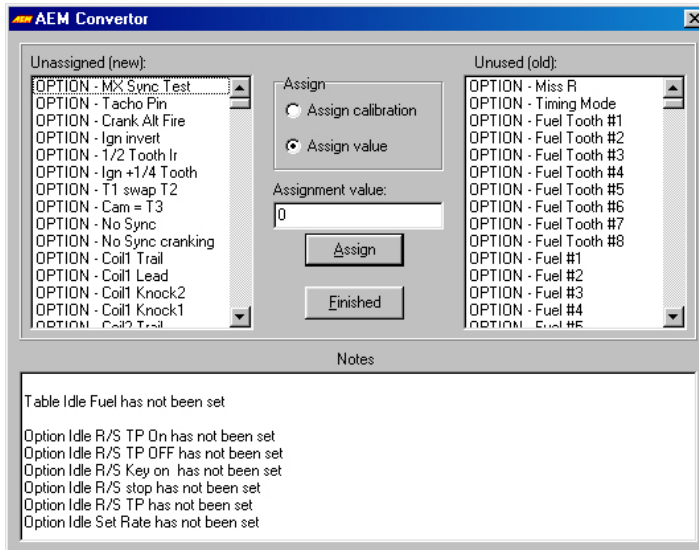
The left list box shows the new options or tables that did not apply to the old calibration file, this is typical when upgrading to newer software that has added features. The right list box shows those items that are no longer used in the newer file (the *Unused List Box*).

The *Converter Window* allows those items in the unassigned list box to be assigned values from either an unused item in the unused list box or a user defined value. Note that when assigning an unused item to an unassigned item, only similar items can be assigned. For example, an option cannot be assigned a table's value but must be assigned an option's value.

To assign an unused item's value to an unassigned item's value, select the unassigned item and the unused item to which the value should be assigned. Click on the *Assign Calibration Box* in the *Assign Group Box* and press the *Assign Button*. The two selected items are removed from the lists.

To assign a value to an unassigned item's value, type the value to assign in the *Assignment Value Box*. Click on the *Assign Value Box* in the *Assign Group Box* and press the *Assign Button*. The selected unassigned value is removed from the list.

When the conversion process is complete press the *Finished Button*. The save window appears showing the current name of the file and a list of all existing calibrations. A specific file name can be typed into the name box at the top left of the window. Highlighting a calibration name causes the notes of that calibration to be displayed in the text box on the right (if any exist) and the name of the file to be saved is changed to that of the selected file.



Converter Window

To save the calibration to that in the name box, press the *Save Button*. If a file with that name already exists a prompt appears asking whether to overwrite the existing calibration. To overwrite the calibration press the *Yes Button*, to choose another name press the *No Button*.

To cancel the save press the *Cancel Button*.

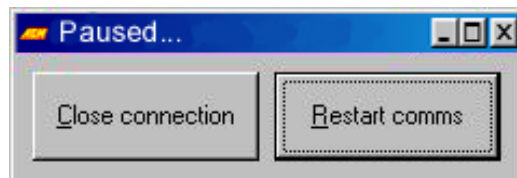
Online Features

Pausing the Comms

If for any reason access to the COM port used by AEMPro is required by another program but it is preferred not to close the connection with the ECU the comms can be paused using the following operation.

- Select *ECU | Pause comms* from the menu

The *Pause Window* appears. To restart the comms press the *Restart comms Button*. To close the connection, press the *Close connection Button*.



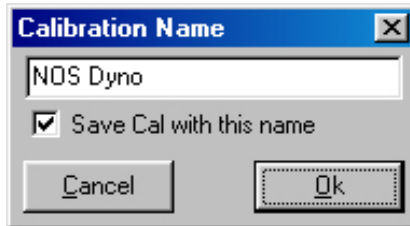
Pause Comms Window

Setting the Calibration Name

Most AEM ECU's have an 8-byte calibration name held within the calibration. A calibration name can be written to the calibration using the following operation.

- Open the calibration (either *Online* or *Offline*).
- Select *File | Calibration Name...* from the menu.

The *Calibration Name Window* appears.



Calibration Name Window

To change the calibration name type in the new name in the *Edit Box* and press the *Ok Button*.

To cancel changes to the calibration name press the *Cancel Button*.

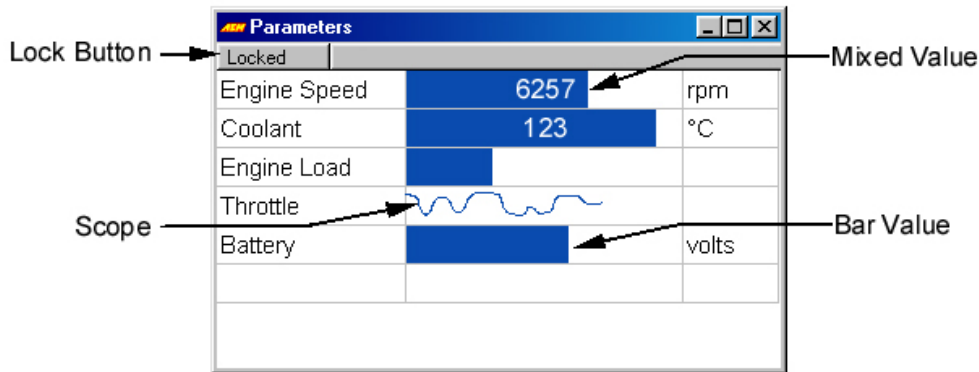
If the *Save Cal with this name Check Box* is checked, the file will also be saved as the calibration name.

AEMPro Shortcuts

Parameter Window

The *Parameter Window* is basically the Window to the engine. In other words it tells you everything the engine is doing, and what all of the sensors are seeing. This window is one of the most valuable tools in helping to tune the engine. The *Parameter Window* can be displayed in several ways.

Parameters are values that the current status of a specific signal, such as engine speed, or load. The *Parameter* window can be viewed both *Online* and *Offline* (values are only displayed when *Online*). *Parameters* are viewed by selecting *Parameters* from the menu. An empty *Parameter Window* appears with a pull-down list box containing the list of viewable parameters. Multiple *Parameter Windows* can be displayed at the same time.



Parameter Window

When a calibration is viewed *Offline* the *Parameter Windows* can still be displayed although no data will be visible. This allows templates to be set up *Offline*.

The *Parameter List Window* allows parameters to be added or modified. (The *Parameter Window* must be Unlocked to edit, see *The Lock Button* below) By selecting an entry from the list the parameter is displayed. Navigating through the list of parameters is accomplished by pressing the Tab button to move down the list or <Shift> + Tab to move up the list. With a parameter selected it is changed by pressing the up or down arrow keys or re-selecting an entry from the drop-down list.

The *Lock Button* enables and disables editing of the parameter window layout. When the button reads locked, the parameters cannot be edited. This is the default state of a parameter window when opened from a template. When the button reads unlocked, the parameters can be edited. This is the default state of a parameter window when opened from the *View* menu. Clicking on it with the mouse toggles the button

A parameter is inserted into the window by right clicking on the appropriate line and selecting *Insert* from the pop-up menu. A default parameter is inserted and the parameter name can then be changed as previously described.

A parameter is deleted from the window by right clicking on the appropriate line and selecting *Remove* from the pop-up menu.

The current value of a parameter is displayed in the mid section of the window in the defined type. There are four different display methods, which display.

- *Value* – Displays the value number in the space.
- *Bar* - Displays the value relative to the lower and upper limits by filling in the space.
- *Mix* - A combined display of both *Bar* and *Value*.
- *Scope* - Displays a history of the values received between the upper and lower limits.

The default display method is *Mix*.

To select the display method for a parameter right click on the appropriate line, then select the desired view from the pop-up menu.

Each parameter has a lower and upper limit that can be set by right clicking on the appropriate line, then selecting *High Limit*, or *Low Limit*. When either of the limits has been exceeded, the chosen display turns red.

The update rate of a parameter can be selected by right clicking. Selecting *Update Rate*, and the required rate from the sub-menu. All rates are relative with rate 0 being the fastest rate and subsequent rates being half the speed of the previous rate. Note that parameters using the *scope* type pan across the display at a rate relative to the update rate.

If the parameter window's width is changed, each parameter area increases in size both in width and height.

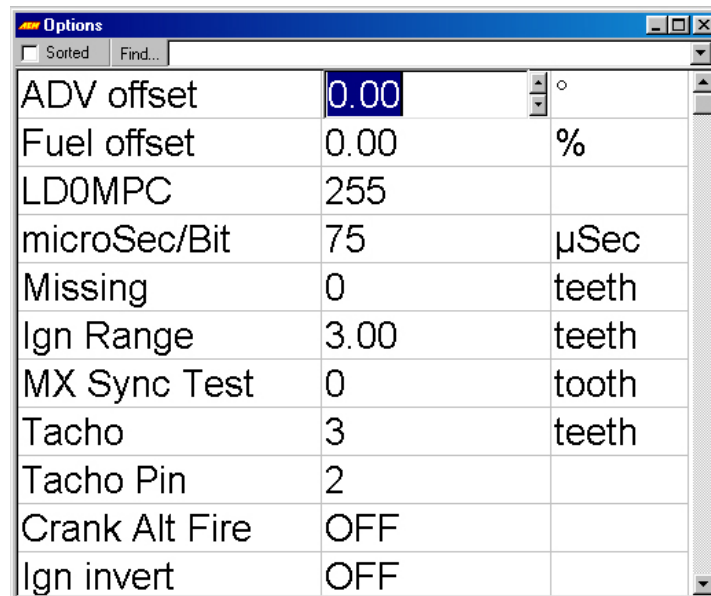
Option Window

Options are single values that are set by the user to change the operation of an ECU. The complete list of options appears in the option window. The list is navigated using the up and down keys to move to the previous or next option respectively. The page up and page down buttons move to the top or bottom of the page or scroll the window up or down if all of the options are not visible.

The option value is changed following this operation.

- Selecting Options from the menu.
- You then get the choice of displaying full list or selected list. A selected list will allow for organizing the options functions in a manner that suits your needs better. Multiple Options windows can be opened.
- Selecting the option to be changed with the mouse will allow for that option site to be edited.
- Typing the required value and pressing the return key.

Pressing the space bar can change options with an ON/OFF value.



The screenshot shows a window titled "Options" with a search bar and a list of parameters. The "ADV offset" value is highlighted in blue.

Parameter	Value	Unit
ADV offset	0.00	°
Fuel offset	0.00	%
LD0MPC	255	
microSec/Bit	75	µSec
Missing	0	teeth
Ign Range	3.00	teeth
MX Sync Test	0	tooth
Tacho	3	teeth
Tacho Pin	2	
Crank Alt Fire	OFF	
Ign invert	OFF	

Options Window

To locate any particular option the *Find Drop-Down List Box* can be used. Pressing the 'f' key highlights the *Find List Box*. To jump a particular option select that item from the list box and press the return key.

Configuring the Main Menu

The menus are pre-configured in groups, and named with a basic industry standard type name. These menus can be user configured in any group, and with any name defined by the user. All menus across the top Window bar will be listed in alphabetical order.

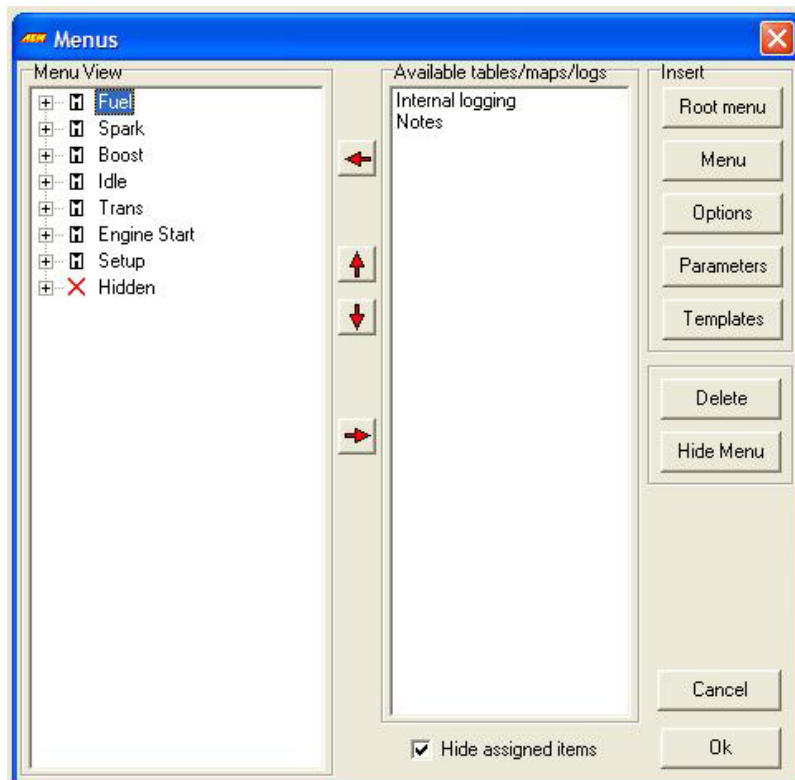
To configure the *Main Menu* follow this procedure.

- Click on *Configure | Menu | Edit* from the menu.

Select a current menu to modify from the *Menu View* window. When adding a *Root Menu*, select the *Insert Root menu* button, this will add a new menu entry into the Menu View window on the left. You can type over the default name, and enter the desired name by selecting the name Menu and then pressing the F2 key or left click on menu a second time.

Sub menus, Options, Parameters and *Templates* groups can be added using the same method as outlined above.

After creating the Menu items and groups, add the available Tables, Maps, Logs, etc. to the desired groups by selecting the Menu or group then use the right and left arrows to add or remove items.



Configure Menu Window

Note: Should you desire to change the layout of the default menus it is important to keep the tables and maps organized into logical groups. This way it is easy to find your way around the system without having to search for a particular table or parameter. AEM has organized the menus into logical groups to make things easier upon start up, however if you find a different grouping makes more sense to you, these menus allow for an endless configuration.

Templates

Introduction

Templates contain information about window sizes and positions on the screen. The Template function is one of the most useful tools to the tuner, allowing quick movements between Maps and Monitoring screens. AEM has made all of the Templates functions to be user configurable, allowing each individual to select the screen layouts they are most comfortable with. This helps save a lot of time in getting familiar with new software


This includes:

- Option Window
- Table Windows - Both graphical and table views.
- Map Windows - Both graphical and table views.
- Parameter Windows - Including the parameters contained within them.
- Status Window
- Notes Window
- Overall Trim Control Window
- Dashboard Windows
- DataStream Window

Templates can be opened from the *Template Buttons* and *Shortcut Keys* allowing different configurations of windows to be instantly brought up for different purposes such as calibrating a fuel map or monitoring the ECU. For example, a fuel template may display the layout and size of the fuel map and selected parameters, or a monitoring template may display other parameter lists and dashboards. Templates are specific to ECU types, however other ECU *Templates* can be run in other ECU's, keep in mind some functions may not transfer to other ECU's.

When a template is used in an *Offline* calibration only those windows that are accessible for *Offline* calibration are displayed.

Template Buttons

When configured, the speed bar contains up to 12 template buttons that allow faster access to commonly used templates. 

To configure these buttons use the following operation.

- Select *Templates | Configure* from the menu

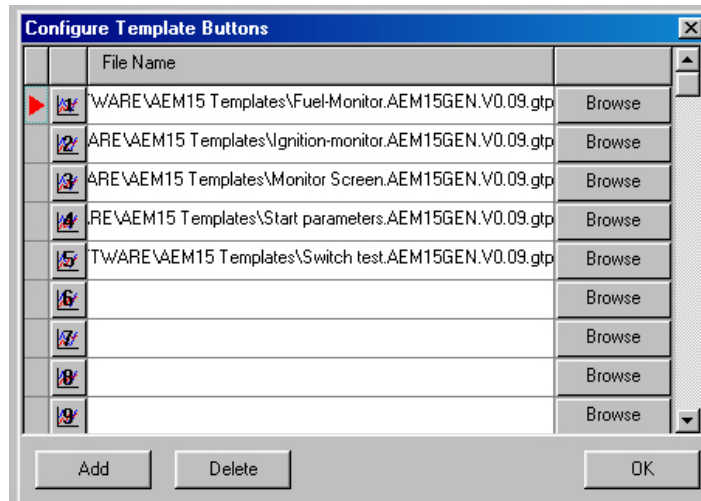
The *Template Configuration Window* appears. When configuring templates for the first time, there are no template buttons shown until the *Add Button* is selected

- Click on the *Add Button* to enable templates.

12 possible slots for the templates will appear.

- Select *Browse*; double click on the template to be configured.

This puts the template on the selected button for the short cut. By clicking on the template button, the default numbers can be assigned images by the user; some images are supplied by AEM.



Template Configuration Window

When finished configuring the template buttons, click the *Ok Button* to finish.

You will now see the template buttons displayed across the top below the menu, by clicking on any one of these the configured screen will be displayed. Also the short cut <Shift> + F1 through F12 will provide the same function as clicking on the buttons with the mouse.

Configuring Additional Templates

To configure the screen templates use the following procedure.

- Arrange windows on the screen, as you would like the template to appear when re-called.
- Click on *Templates | Save* then enter the name for the template to be saved as.
- Click on *Templates | Configure | Browse* then select the Template to be assigned to the short cut.

Default Template

When a calibration is opened the default template is automatically loaded. The default template describes the layout of windows when a calibration was last opened. The default template is automatically saved when a calibration is closed.

Opening Templates

After the template buttons are configured, selecting any one of the template buttons will open the template. If any changes are made to the screen, the template may be re-saved, or saved as a new template (See *Configuring Additional Templates*).

Saving Templates

To save the current configuration of windows as a template use the following operation.

- Select *Templates | Save...* from the menu

The *Save As Window* appears asking for the name, and which folder to store the template. Also at the bottom of the *Save As Window*, there is a drop down box to determine which ECU you are saving the template for, the default is the calibration type being saved from. This can be changed to save it as another ECU type by selecting a different ECU from the drop down box.

To save the window configuration to the given template name, click on the *Save Button*.

To cancel the save, press the *Cancel Button*.

Double clicking on an entry in the list causes that template to be overwritten.

Deleting Templates

To delete an existing template use the following operation.

- Select *Templates | Configure...* from the menu.

The *Configure Window* appears.

- Select the template to be deleted (the red arrow points to selected template)
- Click on the delete button to delete the selected template, and the template will be deleted.

When no more templates are to be deleted press the *Ok Button*.

Running Templates from another ECU

If you choose to load pre-configured templates from another ECU it can be accomplished by following these steps.

- Select *Template | Run* from the menu
- The *Windows Open Dialog Window* appears; select the file types drop down arrow and select the desired ECU type to run.

Note: If you wish to configure the selected template as a permanent template button, then you must select the file type from the *Template | Configure* menu instead of the run menu.

Dashboards

Introduction

Dashboards are user-defined windows that allow various graphical representations of incoming data from a connected ECU. All of the parameters can be displayed in the Dashboard configurations as a variety of gauge types. These gauges can be grouped together in a single dashboard or kept singularly.

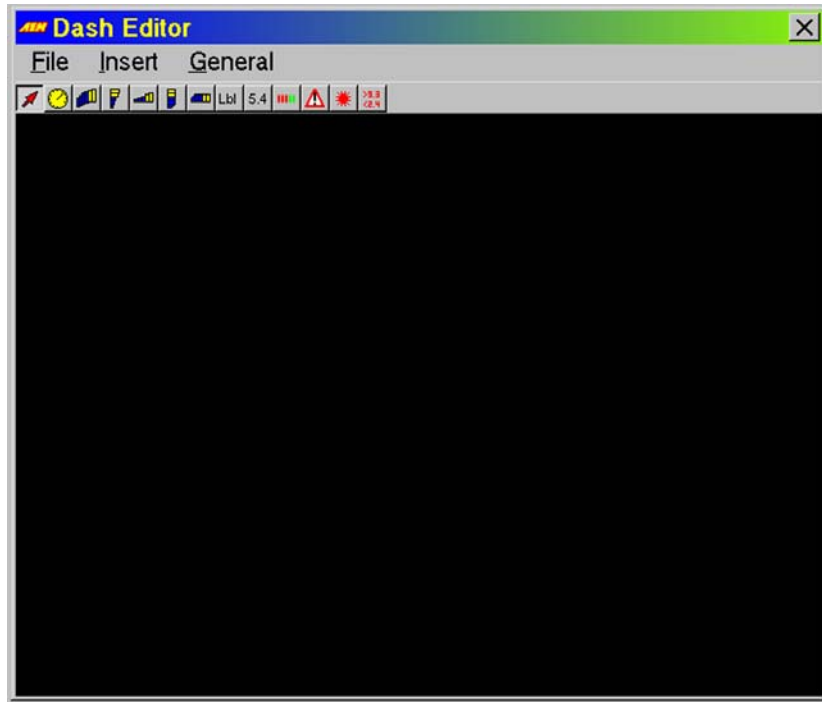
Dashboards are only functional *Online* and are specific to ECU types. Once a dash is configured, it can be saved as a template for easy access for use during dyno sessions. We usually save the dash as a window so it may be viewed on top of an existing window.

Configuring a Dashboard

To configure a dashboard use the following operation.

- Select *Templates | Dash | Configure* from the menu.

The *Dash Editor Window* appears. This window allows creating, viewing, and modification of dashboards for the open ECU type.



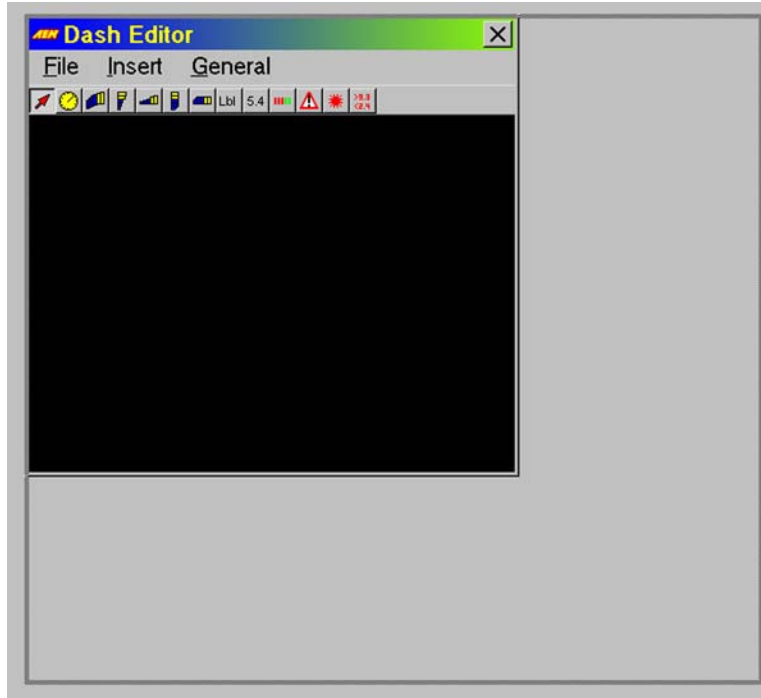
Black Dash Editor Window

Resizing the Dash Editor Window

The *Dash Editor Window* can be resized as required. When a dashboard is saved the size of the *Dash Editor Window* is also saved and is used to determine the size of the dashboard when it is displayed. Resizing the *Dash Editor Window* **does not** resize the gauges within it.

When a dashboard is opened, the *Dash Window* is automatically resized according to the saved size. Resizing the *Dash Window* causes the gauges contained within it to be resized.

With this in mind it is generally better to size the *Dash Editor Window* such that it just contains all the gauges.



Dash Editor Window Resize

Creating a New Dashboard

To create a new dashboard, use the following operation.

- Select *Template | Dash | Configure* from the menu.

The *Dash Editor Window* resizes to the default size and the window is cleared.

Adding a Gauge

To add a gauge to a dashboard, use the following operation.

- Select the type of gauge required from the Insert menu or click on the appropriate button in the toolbar.
- Left click on the dashboard at the required location.

Deleting a Gauge

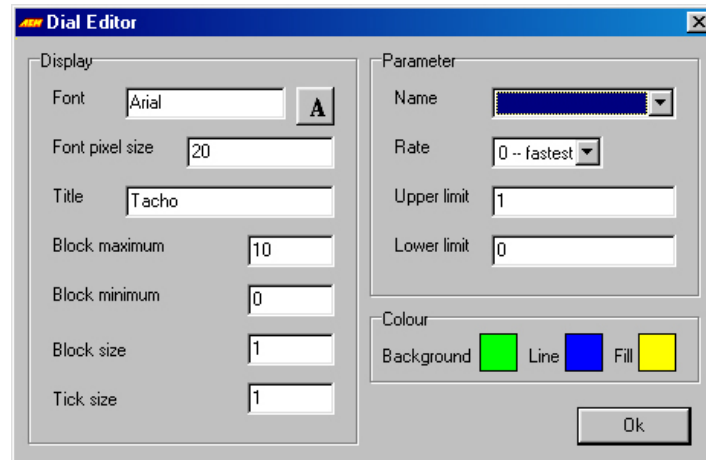
To delete a gauge, use the following operation.

- Highlight the required gauge by clicking on it with the left mouse button.
- Press the delete key.

Setting a Gauge's Attributes

To set a gauge's attributes, use the following operation.

- Right mouse click on the appropriate gauge and the gauge editor window appears showing details of the gauge.



Dial Editor Window

The *Gauge Editor Window* has 3 regions defining the display of the gauge, where it gets data from and the Color of the gauge. The effect of the display region is detailed in the section *Gauge Types*.

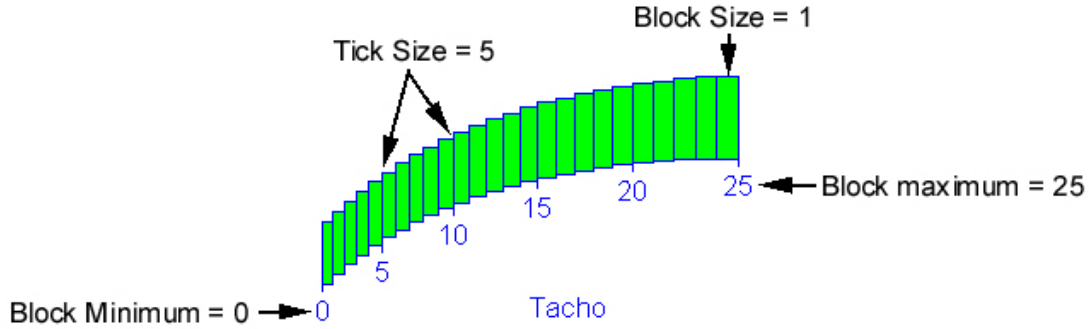
The parameter area defines the parameter used to obtain data for the gauge and how quickly it is obtained. It also defines the upper and lower values, which are considered 'in-range'. When the data exceeds these values an error is generated to which specific gauge types react. For example, if the parameter is coolant temperature the upper limit may be set to 110. If it exceeds this value an error is generated which may be acted upon by a message gauge or warning gauge.

The Color area defines the colors used to draw the gauge. The gauge is drawn in the background Color using the line Color for borders. When the dashboard is used the gauge appropriate areas of the gauge are filled using the fill Color.

Gauge Types

Bar Gauge

The bar is made of connected blocks forming an arc that are labeled at defined intervals. The title is displayed below it. The blocks are filled from left to right as the parameter value increases.

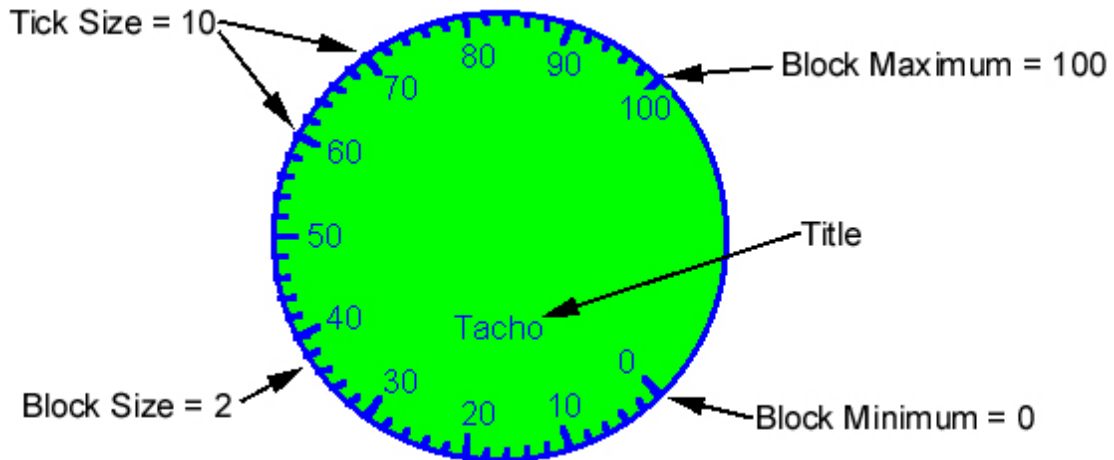


Bar Gauge

- Tick – The number of blocks between each numbered mark.
- Block Minimum – The minimum displayed value.
- Block Maximum – The maximum displayed value.
- Block Size – Number span of each block.

Circular Tachometer Gauge

This gauge has marks around the range of the tachometer, which are labeled at defined intervals. The title is displayed inside it. The circular tachometer has the same attributes as the bar tachometer.

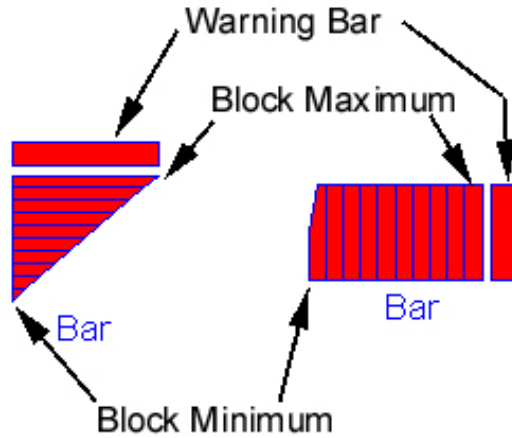


Circular Tachometer Gauge

Triangular and Square Bar Gauges

There are 4 different bar gauges composed of vertical or horizontal and triangular or square characteristics.

When the limit of a parameter is exceeded, the warning bar at the top or right highlights in the warning Color.



Bar Gauges

Label Gauge

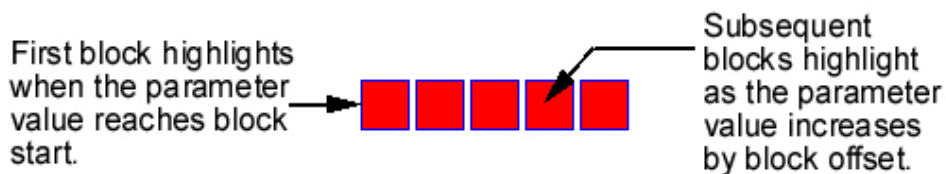
The label gauge displays a fixed string of text. The font type and size and the title are the only required data.

Value

The value gauge displays a parameter as a value. The font type and size and parameter details are the only required data.

Limit Mark Gauge

The limit mark gauge is generally used to signal an approaching limit. As the block start value is reached the first of a user defined number of blocks lights. As the value progresses by the block offset value each subsequent block is lit.



Limit Mark Gauge

Message Gauge

The message gauge displays warnings generated by other gauges. When a warning is generated the blocks either end of the message highlight in the warning Color.

Warning Gauge

The warning gauge is a block that changes to the warning Color when a warning is generated by another gauge.

Out-of-Range Gauge

This is a gauge that is only visible in the editor. The gauge monitors a parameter value and generates a warning when it exceeds either of the limits.

Setting the Warning Color

To set the warning Color of a dashboard, use the following operation.

- Select *General | Warning Color...* from the dashboard menu.

The *Color Window* allows a Color to be selected. All gauges that have an error condition use this Color. Note: If an existing dash needs to be modified see (*Opening an Existing Dashboard*).

Setting the Background Color

To set the background Color of a dashboard, use the following operation.

- Select *General | Background Color...* from the dashboard menu.

The *Color Window* allows a Color to be selected.

Note: If an existing dash needs to be modified see *Opening an existing dashboard*.

Saving a Dashboard

To save an existing dashboard, use the following operation.

- Select *File | Save As...* from the dashboard menu.

The *Save Dash Window* appears showing the list of available dashboards.

- Type a new name in and press the *Ok Button* or double click on the dashboard to overwrite.

The *Save Dash Window* closes.

Opening an Existing Dashboard

To open an existing dashboard, use the following operation.

- Select *File | Open* from the dashboard menu.

The *Open Dash Window* appears showing the list of available dashboards.

- Select the name of the dashboard to open and click the *Ok Button* or double click on the dashboard to open.

The *Save Dash Window* closes.

Deleting a Dashboard

To delete an existing dashboard, use the following operation.

- Select *File | Delete...* from the dashboard menu.

The *Delete Dash Window* appears showing the list of available dashboards.

- Double click on a dashboard or type the name of the dashboard and press the *Delete Button*.
- To close the *Delete Dash Window* press the *Cancel Button*.

Viewing and Calibrating Tables and Maps

Calibrations are viewed and edited by selecting the *Table / Map* to be calibrated from the main menu. Details on viewing / editing each of the different types of windows are given below.

Calibrating the ECU

In this section we will be getting into the “Heart” of AEMPro’s calibration software. We have gone to great lengths to add flexibility into the system so that the tuning procedure can be accomplished in a relatively short period of time. With standard Windows copy and paste tools, along with AEMPro’s ability to use the mouse to select and manipulate sites, tuning time is greatly reduced.

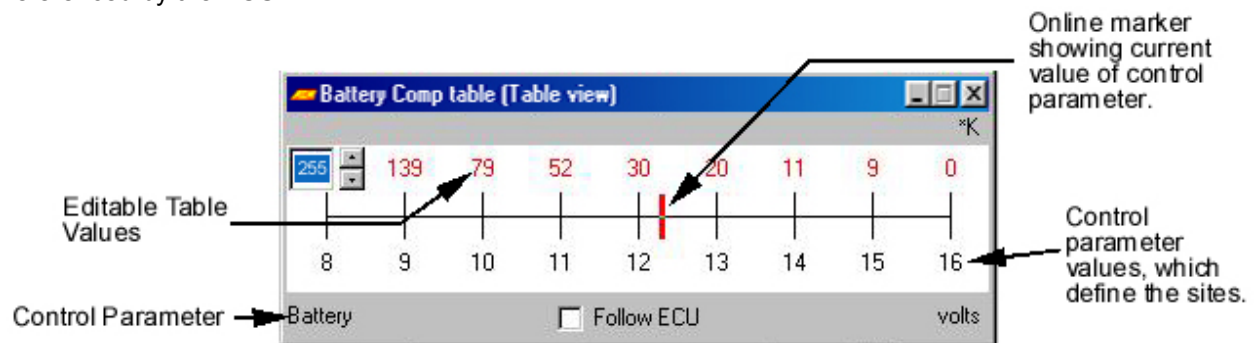
There are 2 ways to view the data going to the ECU, in a graphical display (2 dimensional or 3 dimensional), or in a table value display (2 dimensional or 3 dimensional). Two-dimensional displays are based on 2 parameters to determine how the data will be used (As in Figures 38 & 39). Three-dimensional displays are based on 3 parameters to determine how the data will be used (As in Figure 40).

First we will discuss the different features available for adjusting the data in the *Table View*.

Table View

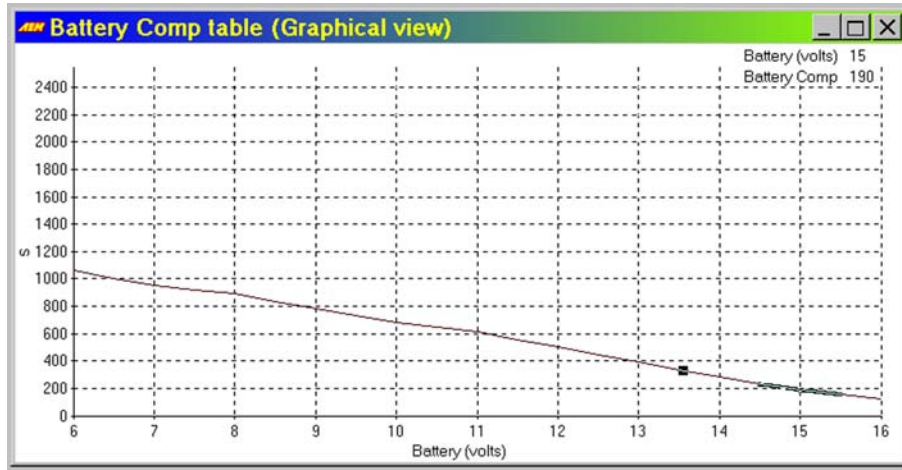
The Table window displays information in numerical form. The ECU references the sites in these tables to perform calculations that determine (in part) the overall signal output of the ECU.

The table view of the window shows the various sites that can be edited, and the corresponding site values are referenced from. If the calibration is *Online* a marker also shows the current site being referenced by the ECU.



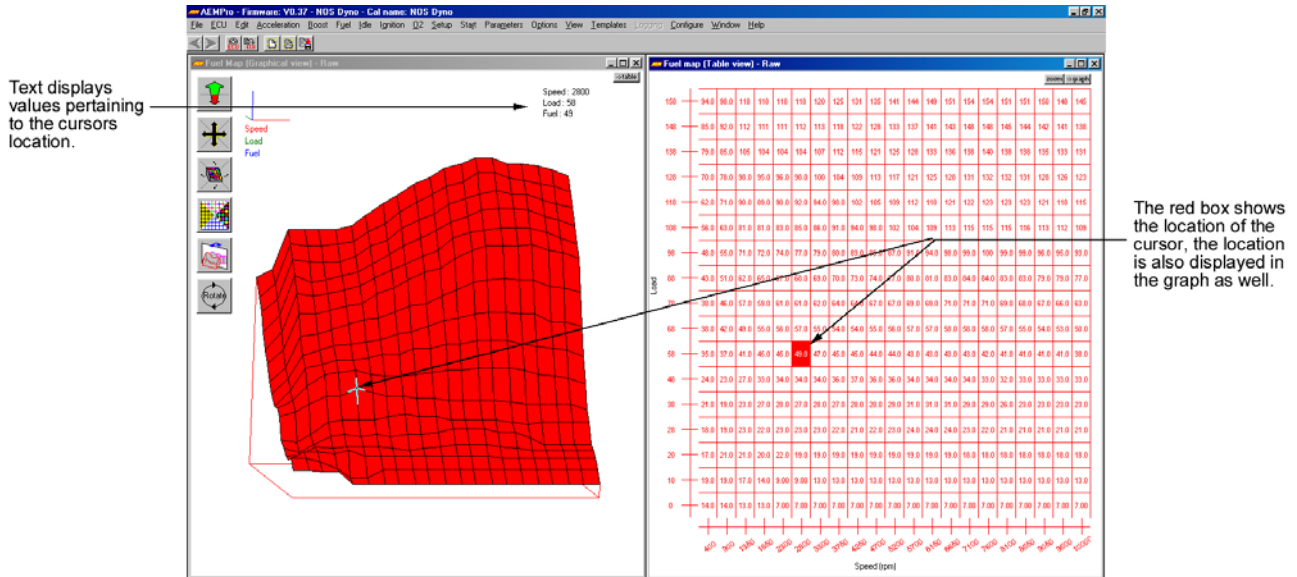
Battery Injector Compensation in 2D Table View

The table values are written in color, the colors may vary depending how the value was adjusted (see Color changes).



Battery Injector Compensation in 2D Graph View

Single Site Selection



Single Site Selection
3D Graph on the left and 3D Table on the Right

To navigate through the values use the cursor keys, or directly click on the site with the mouse. The cursor location in the table is highlighted, while the Graph site is highlighted as well. There are several ways to adjust the values at this point

- Pressing the '+' or '-' key to increase or decrease the value by a single increment.
- Holding the "Ctrl" key while pressing the "+" or "-" will increase or decrease the value by 10 increments (equivalent to pressing the "+" or "-" key 10 times).
- In *Table View*, typing the required value and pressing the return key will change the number to nearest increment entered (if a negative value is required press the '-' key after typing the number, entering the '-' key first will result in a straight number entry).

A value can be copied from the current site by holding the <Alt> key and pressing the arrow key in the desired direction to be copied. Holding an arrow key down will provide a continuous copy in the direction selected.

Group Site Selection

Selected sites to be adjusted are highlighted then by right clicking with the mouse, the usable functions are displayed as well as viewing options. Notice the graph also shows selected sites to give the tuner a better picture of how the changes will affect the map.

Pop up menu containing all of the edit functions

Group Site Selection

- Holding the <Shift> key and pressing the *arrow* keys, selected sites will be highlighted.
- Pressing the left mouse button on an end site, dragging to the other end site and releasing the mouse, again, selected sites will be highlighted.

Fuel Map Table View

When viewing the fuel map several further options are available. Upon right clicking on the map or pressing the 'm' key, the standard menu appears with some or all of the following additions:

- View raw – This is the raw calculation number that is multiplied with other factors to give the final pulse width.
- View pulse width – This is the calculated pulse width that is delivered to the injectors from the base map. This pulse width excludes any modifiers for engine temp, air temp, etc..
- View duty cycle – This is the percentage of the injector that is being used at each point.
- Rescale fuel map
- Optimize fuel map

The three view options are always available for a fuel map, and define the units in which the map is drawn. The current selection (by default *View Raw*) is ticked. *View Raw* shows the raw value from the map ranging between 0-255. *View Pulse Width* shows the actual pulse width before any other modifications, in milliseconds. This is calculated by multiplying the *Raw* value by the value of the *option MSPB* or *MicroSec/bit*. Selecting *View Duty Cycle* brings up the duty cycle injection type window. This asks for the number of injections per cylinder per revolution from the choice of ½, 1 or 2. The fuel map then shows the percentage of time that the injectors are actually open. Note that a value exceeding around 90% can cause the injectors to work incorrectly due to opening and closing times.

Edit Functions in Table View Pop-up Menu

The selected sites can then be edited by right clicking on the table or pressing the 'm' button. The function desired is then selected from the pop-up menu by selecting it with a mouse click. The functions available are:

- *Copy* - The selected area is copied internally, so that a paste function can be used to "copy" the site(s).
- *Paste* - The last copy selection is pasted into the selected area. If the number of sites contained in the copy is different to the selected area, the copied sites are interpolated. For example, two sites containing 0 and 2 are copied. A group of three sites are selected and the paste command is selected. The sites are pasted with the values 0, 1 and 2.
- *Calculate* - the two values at either end of the selection highlighted are interpolated. For example, 3 sites are selected. The first and third site contain 0 and 2 respectively and the calculate command is selected. The first and third sites remain unchanged while the second site's value is set to 1.
- *Change* - An edit box prompts for a value. The selected sites' values are then changed by the supplied value. For example the value was 10, a 5 is entered in the *change* function, 15 will be the new number, if -5 was entered then 5 would be the new number.
- *Function* - An edit box prompts for a function, this feature is equivalent of a calculator. The selected sites' values are then affected by the *function* to determine their new values. The *function* provided allows the use of the open and close brackets, multiply (*), divide (/), plus and minus and numbers. Any other character supplied in the equation is considered to be the value of the site that is being changed. For example, two sites are selected containing the values 0 and 2 and the function '(x * 2) + 3' is provided. The first and second sites are set to 3 and 7 respectively.
- *Set Value* - An edit box prompts for a value. The selected sites' values are all set to this value. For example if the entire map is highlighted, *Set Value* was selected, and a number of 10 was entered. The entire map would now have a new value of 10.
- *Percent change* - An edit box prompts for a value. The selected sites' values are changed by this percentage. So if you want to add 10%, then enter 110 if you enter 50, you get 50% of the value that was there. In other words you want to enter the percentage of the current site(s) you want.
- *Reset States* - Sets the Color change iteration to an unchanged state.

- Pressing the 'Z' key (zoom), will zoom in on the table or graph view.
- Pressing the 'S' key (swap), "swaps" between the table and graph views.
- If the *Follow ECU* box is checked, the site closest to the live location in the map is highlighted. To turn the *Follow ECU* on or off, click on the *Follow ECU* box, or press the 'F' key. The *Follow ECU* box is only available for *Online* calibrations.
- Pressing the space bar while on the table view of the fuel or ignition table freezes the cursor at the position where the space bar was pressed.

Change Injectors/Pressure Function

The Change Injectors/Pressure function allows the tuner to scale an existing calibration file (.gdf) for the use of different size injectors or increased/decreased fuel pressure in one step.

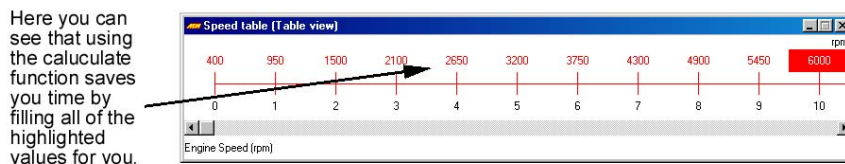
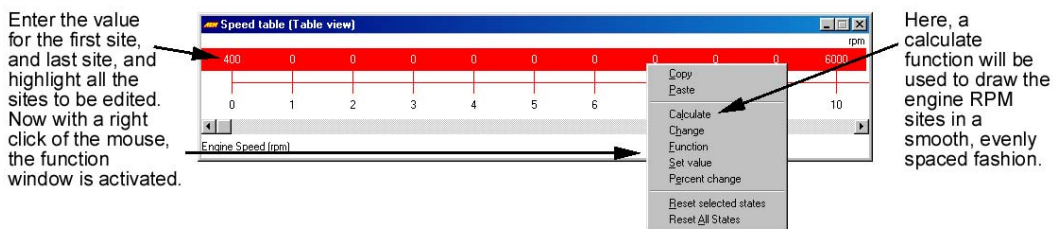
When using this function it is very important to know the correct size/flow rate of the injectors the original calibration file was created on and the size/flow rate of the new injectors. This will allow an accurate adjustment of the fuel setting by the AEMPro software.

This function will not only rescale the fuel map, but also will rescale all fuel functions associated with starting and idle as well.

To use this function:

- Select the *Fuel* drop down menu
- Open the *Fuel map| table*
- Right click anywhere on the table
- Select *Change injectors/pressure* from the menu
- Type in the required information then click OK

Note: It is a good idea to save the calibration file before making this change, then after making the changes save the file as a new name.



Calculate Function

Editing 2D Graphs

Keyboard Functions in 2D Graphs

- In all of the Tables/Graphs the Arrow keys provide movement throughout the graph.
- The “+” and “-“ keys provide increase and decrease on the selected site.
- Holding the “Ctrl” key while pressing the “+” and “-“ provides a times 10 increment (as if pressing the “+” or “-“ key 10 times).
- Selecting the “F” key enables the *Follow ECU* function.
- Selecting the “S” key swaps between the graph and the table view.

Mouse Functions in 2D Graphs

- Pressing the left mouse button on a site, dragging the mouse across an area Draw the 2D curve with the mouse pointer. Note: Dragging the mouse too fast can result in “drop outs”, this is a windows software setup issue, depending on the update rate of your mouse.
- Selecting an individual site with a left mouse click will also allow dragging the site up or down accordingly.
- Also as with all windows in Windows, the mouse allows for re-sizing, and re-positioning of the windows.

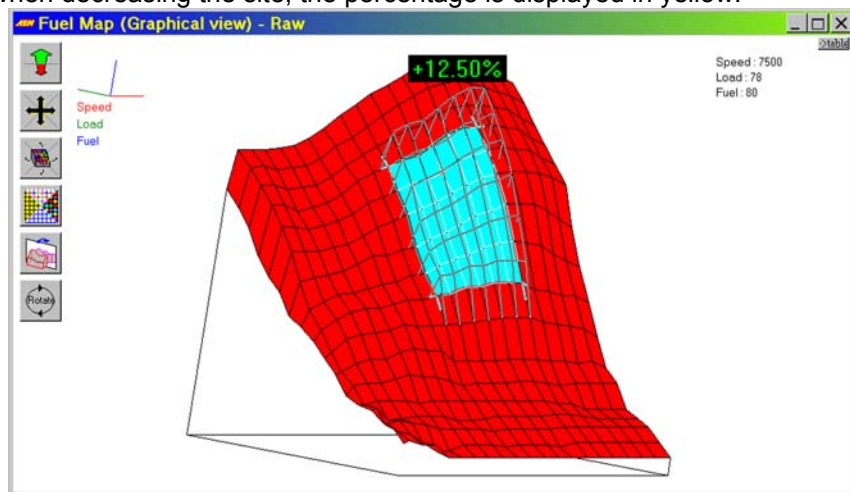
Editing 3D Graphs

Keyboard Functions in 3D Graphs

- The “+” and “-“ keys allow for increase and decrease in the selected site.
- Holding the ‘Ctrl’ key and the “+” and “-“ keys allow for 10 times increase on selected sites.
- Arrow keys allow for movement around the 3D Maps.
- Pressing the ‘S’ key allows for swapping between the Graph and Table.

Mouse Functions in 3D Graphs

- Selecting a site or series of sites by holding the left mouse button down, and dragging the mouse across the group of sites to be changed (shown by highlighting the sites as you select them). Once selected, Right click with the mouse, a window then appears with a percentage displayed. While holding the right mouse button down, move the group of sites up or down to make the desired change in percentage. Note: When increasing the site, the percentage is displayed in green, when decreasing the site, the percentage is displayed in yellow.



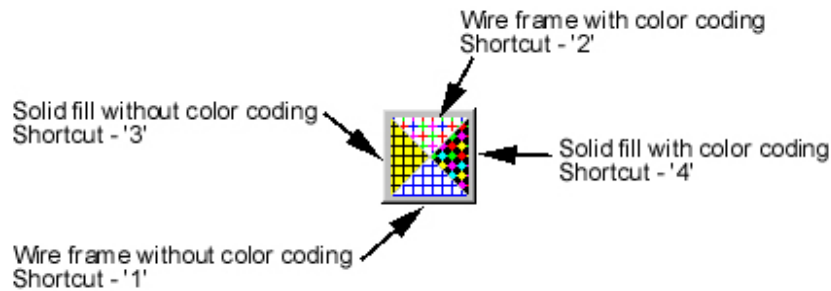
Calibration Change by Dragging

- *Rescale Fuel Map* - Changes the fuel map values and the option *MSPB* or *MicroSec/bit* such that the pulse width at every site remains constant but the maximum value in the fuel map is 240. This can be used to obtain a greater resolution for fuelling when the highest value was lower, and allows the pulse width to be widened if the resolution was too small.
- *Optimize Fuel Map* changes the fuel map values, the option *MSPB* or *MicroSec/bit* and the option *LD0MPC* such that the resolution is increased throughout the fuel map. Some explanation of the option *LD0MPC* is needed to explain how this differs from the functionality of *Rescale Fuel Map*. *LD0MPC* is a fractional scaling factor applied to the 0 load line that progressively increases to 1 on the full load line. For example when *LD0MPC* is 128, the 0 load line values are halved ($128 / 256$) to obtain the actual fuel map value, the full load line values remain unchanged and those in between are proportionally scaled. Hence with this value, the resolution of the 0 load line fuelling is doubled. This is particularly useful when calibrating fuelling for low load sites and stable idling.

Graphical View

The graphical view of a map shows a graph of the values against the control sites. Four buttons are located on the left of the window allowing view changes to the graph.

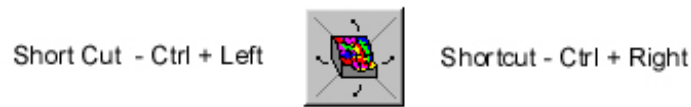
The graph is drawn in 4 different modes including wire-frame models and solid fill models both with and without Color-coding. These modes are selected by clicking on the mode button or shortcut key:



Color Mode Button

The graph can be rotated in two different styles a quadrant rotation and a dynamic rotation.

Shortcut - Ctrl + Up



Shortcut - Ctrl + Down

Quadrant Rotation Button



Dynamic Rotation Button

Note: The dynamic rotation may be limited by the performance of the graphics card installed in your computer.

The graph can also be moved by clicking on the move button or using <Shift> + cursor key and zoomed in and out using the zoom button or 'Z' to zoom in and 'X' to zoom out. Finally the graph can be reflected with the reflect button or pressing the 'R' key.



Move, Zoom, and Reflect Buttons

Slice View

The slice view of a map shows a graphical slice of the map taken through one of the axes.

The sites are written in different colors depending on their state (See Iteration changes).

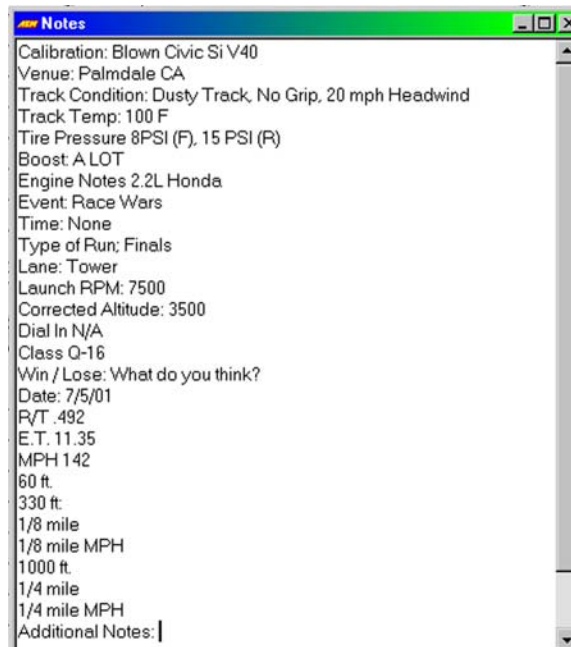
To navigate the slice, use the left and right cursor keys. The current site is highlighted and the value of the current site is written in the top right hand area of the window. The value can be changed as per graphical view.

If the ECU is *Online* a small block signifies the position of the non-axis control parameter's current value. If the follow ECU box is checked, as the appropriate axis control parameter changes the current slice changes to show the nearest site. To check or uncheck the box either click on it or press the 'f' key. The follow ECU box is only available for calibrations *Online*.

Pressing the 'S' key (switch) changes the view to show the other axis' slice.

Notes Window

This allows notes to be added to the calibration file. These are only held in the Calibration file on the PC and are not held in the ECU. The Notes section is useful for keeping track of the performance of the calibration and race event results. This is a sample of the type of information that would be useful in the notes section of the calibration.

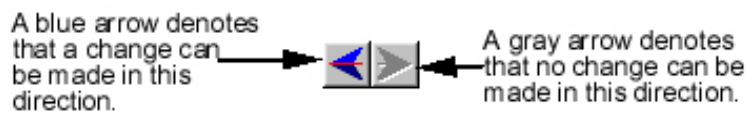


Typical Notes Window

Undoing and Redoing Changes

When a change is made to the calibration either *Offline* or *Online* the facility to undo and redo any changes is available. The edit facility is affected by selecting *Edit | Undo* from the menu. If the last action performed effected more than one location, the undo facility will undo every change made for that action. The undo facility is not limited to a single action, but can remember the entire session. If the undo facility is used, the redo facility then becomes available. This is affected by selecting *Edit | Redo* from the menu. This will perform the last action that was undone. For example, if the fuel map is selected and the optimize option is selected from the pop-up menu, the whole map and two options are changed. Effecting the undo option after this action causes the original values to be re-entered into the map and options. Subsequently affecting the redo option causes the optimized values to be re-entered into the calibration. Any values that are undone or redone have their Color status set to undone, which is gray.

Also available is the Forward and Back Browser keys. Used like a web browser to move around the evolving calibration.



Undo / Redo Buttons

Ignition (Spark) Configuration

The AEM EMS has several tables and options that make up the final spark advance. With knock sensor feedback, these tables and options can speed up the tuning process immensely. It is very important to familiarize yourself with the capabilities of each option, and table function to prevent any engine damage.

Idle Spark

This table is found under the idle menu for it pertains more to idle control. It does, however seriously affect the timing readings at idle. If the ignition timing is being synchronized, make sure this table is set to zero.

AIT spark

This table allows you to trim the ignition timing against air inlet temperature. For example: If you wanted to retard the ignition timing to prevent detonation as inlet temperatures started climbing, this would be accomplished with this table.

Knock Noise

This table is to filter out any background engine noise. Set this table by making a conservative ignition map and datalogging the knock raw signal to determine the values for this table. See: Knock Control for further details on setting up the knock feedback.

Coolant Retard

This table allows ignition advance to be trimmed against coolant temperature. This is typically used for quickly heating up catalytic converters, and cooling an engine down in an overheating situation.

Ignition map

This is the Main ignition map that determines the ignition timing to the engine. All trims are calculated after the figures in this map.

N2O ignition map

This map trims the ignition timing when Nitrous oxide is used in +/- ignition degrees while the nitrous is active.

Spark 1-10 mod

These tables allow for individual cylinder trim of ignition timing against engine speed.

Engine Start Functions

There are several tables and options that affect starting the engine. The starting condition is defined as whenever the engine rpm is above Crank Min (usually 50 rpm) and below Crank Exit (usually 400 rpm).

Whenever the engine is cranking the fuel and timing delivery is determined by the following options:

Crank Min

This is the minimum rpm before any fuel and spark will be delivered. This value is pre-set by AEM to 50 rpm.

Crank Exit

This is the engine speed that determines when the fuel and timing will switch over from the cranking condition to the run condition. Note: when the engine exceeds the crank exit speed, the fuel and ignition will be derived from the fuel and ignition tables plus any trims that are active. This value is set to 400 rpm by AEM

Crank Advance

This is the amount of desired ignition advance while in the starting (cranking) mode. A typical value is 10 degrees advance.

Crank fuel

This is the amount of fuel in VE (raw) numbers against throttle position, multiplied by the microsec/bit option + Warm up table fuel if any, to give the cranking fuel pulse width. If the engine wants to fire easily when the throttle is opened, typically this means there is too much crank fuel. If the engine cranks excessively before firing, and throttle input doesn't help, this typically means there is not enough fuel. Note: It is a good idea to have all of the fuel level for the first 15 to 20% throttle, then taken out at high throttle conditions, this will help in determining a proper crank fuel setting and also clear extra fuel in the event the engine becomes flooded.

Crank Pulse

This table allows an additional "Pulse" of fuel against coolant temperature in addition to the crank fuel in the cranking mode. Unlike the crank fuel, this is a momentary pulse when an rpm signal is realized.

Start Extra

This is fuel that is added when the engine exceeds the crank exit speed, and is taken out over the start decay time. Start Extra is used when an engine starts, enters the idle condition, then stalls immediately. Adding Start Extra fuel in this case, helps the engine establish a stable idle before running off of the fuel map alone. Note: The fuel map will also affect this condition, it is important to get the engine to idle well, in a warmed up state, before "fine tuning" with the Start extra fuel.

Start Decay

This is a timetable that determines how long the Start Extra fuel will stay.

Warm up table

This table adds a percentage of fuel against coolant temperature. As the engine warms up to operating temperature, the additional percentage is typically taken out completely. Note: Setting the starting fuel: Once the engine starts consistently well when warmed up, it is important to ONLY adjust this table when cold starting is a problem. If the crank fuel table is adjusted, problems starting the engine warm may occur.

Fuel Table Configuration

There are several options that pertain to the fueling abilities of AEMPro. We will discuss how to use the basic tables that apply to fuel delivery, as well as the options that set them up.

AIT fuel

This table is air inlet temperature against percentage of fuel increase/decrease. The basic compensation has been set by AEM, this table can be defined by the user to compensate in any way the user sees fit. Example: If you wanted to add fuel if the air inlet temperatures start to climb to help prevent detonation, this would be accomplished with this table.

Baro Fuel

This is the table that compensates against barometric pressure. The basic compensation for barometric pressure has been set by AEM. If you were to travel to very high altitudes and found the need to trim the overall fuel, this would be accomplished with this table.

EGT Fuel

The AEM EMS allows for adding fuel against Exhaust gas temperature. This is a user-defined table; the values are at zero from AEM.

Fuel Map

This is the Main fuel map that determines fuel delivery to the engine, also known as the "VE" table.

Injector Advance

This map determines the injector advance in load vs rpm. The basic injector advance curve is set by AEM, fine tuning of this map will vary from engine to engine.

N2O Fuel Map

This fuel map is a "Trim" against the main fuel map in percentage of fuel, and is only used when the nitrous is activated with a switched input to the AEM EMS. (See: Setting up Nitrous control)

Fuel 1-10 mod

These trim tables allow for individual cylinder trim of fuel +/- in percentage against engine rpm.

MAP (Manifold Absolute Pressure) Sensor Configuration

The AEM EMS is very flexible in allowing any 0-5v pressure sensor to be used as input for a manifold pressure based load. These sensors are typically all linear in response, making the setup rather straightforward.

The Parameters Map Min and Map Max are used to determine the 0-100% load range.

Map Min

Units: Voltage (0% load)

This is the minimum voltage output that will be used to determine the lowest load site in the Fuel/Ignition maps. It is important to understand that there are 17 load sites in the 3d fuel and timing maps, and you want to maintain the maximum usable resolution. The bottom line is the lightest load, and is equal to the value entered in MAP MIN. Example: IF a 5 bar map sensor is used, and the manufacturers specifications said that .5 volts is equal to 10 Kpa, and .75 volts is equal to 20 Kpa, and you decide that you do not want to sacrifice any resolution to have adjustability below 20 Kpa because your engine will never see that load condition except in over run. You would enter .75volts for map min, and your bottom load line would be equal to 20 Kpa (as specified by the manufacturer 20 Kpa = .75volts)

Map Max

Units: Voltage (100% load)

This is the maximum voltage output that will be used to determine the highest load site in the Fuel/Ignition maps. It is important to understand that there are 17 load sites in the 3d fuel and timing maps, and you want to maintain the maximum usable resolution. The top line is the highest load, and is equal to the value entered in MAP MAX. Example: IF a 5 bar map sensor is used, and the manufacturers specifications said that 5 volts is equal to 500 Kpa, and 4 volts is equal to 400 Kpa, and you decide that you do not want to sacrifice any resolution to have adjustability above 400 Kpa because you do not plan on running any boost beyond 400 Kpa. You would enter 4volts for MAP MAX, and your top load line would be equal to 400kpa (as specified by the manufacturer 400kpa = 4 volts)

User Scalars

Setting up the Load axis for Kpa, Psi, or Bar

In version .73 software and later, AEM has added the ability to “scale” the sensors in various units of measure. We will now discuss the process involved in setting these up. First go to Configure Units from the main menu. You can then select any of the preset units and sensors from AEM, or add your own.

Scalar options

Active

Check the appropriate scaling for the desired input. A green checkmark will display on the active scaling.

Name

Enter the name for the Sensor scaling you wish to use. Example: GM 3bar

Units

Enter the desired units of measure to be displayed. Example: Psi for load.

Multiplier

This is the multiplier to be used to arrive at the appropriate scaling. The default scaling is 0 to 100%. To determine the value to be entered, use the following equation.

$$(\text{Maximum sensor value to be used} - \text{offset}) / 100 = \text{Multiplier}$$

Note: when scaling for Psi, a negative pressure number would be used for the vacuum side and since two negatives make a positive, you would add your max sensor reading with your offset number.

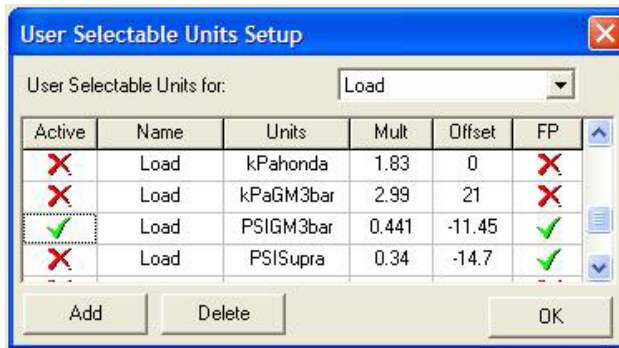
Offset

This is the minimum value to be displayed on the bottom line of the fuel/timing maps. The Map Min value should equal this offset. Example: If the minimum reading the map sensor was capable of was 20 Kpa, then you would use an offset of 20 Kpa. Your Map min should represent the voltage equal to 20 Kpa. Or say you have a 2 bar map sensor, and wanted to scale your pressure readings in Psi, then your offset might be -14.7psi (for vacuum)

FP

This allows the use of decimal points. If using units that need to display decimal points such as pounds per square inch(Psi), Bar, etc., enable this option (Green Checkmark).

In figure 42a the example line PSIGM3bar shows the mult=.441 (.441x100=44.1psi full scale range)
Offset=-14.7 (44.1-14.7=29.4psi positive pressure)



User Scalars Window

Warning: Making changes to the parameters, MAP Min or MAP Max will directly affect the User Scalar values.

Understanding Idle Air Control (IAC) Systems

Idle air control (IAC) systems are used to stabilize idle speed during cold engine and after warm-up operations. The IAC system regulates the volume of air bypassed around a closed throttle butterfly valve. The EMS controls the IAC system by applying various input signals from the user-programmable software file. There are two major types of IAC systems. The stepper idle air control motor is, typically used by Toyota, Mitsubishi, and Eagle. The pulse width idle air control valve is commonly found on Hondas. This instruction manual will address both types of IAC systems.

The stepper motor IAC valve consists of a step-motor with a seat, magnetic rotor, valve, four wires to each of the four coils and can vary bypass airflow by positioning its valve into one of many possible steps. Basically, the higher the IAC valve step number, the larger the airflow opening and the greater the volume of air bypassed around the closed throttle. However, if a voltage pulse is applied backwards, the motor will step in the other direction. The motor step will open or close, based on the number of pulses and the direction desired.

The advantage of a step type IAC motor is that once the motor is in the proper location, no signal or power is required to maintain this position. The only time action needs to be taken is when changing the location of the motor. The downside is there is an uncertainty to where the motor is at any given time. This can be overcome by routinely resetting the IAC motor to a known location. With tuning, this is achieved by stepping the motor all the way to its limit. However, make sure this does not damage the motor. This will reset the motor and is annotated in the options menu by "R/S".

Stepper motors do not have a position sensor. The location at engine start has to be assumed since there is no time for it to reset. Therefore, it must be parked in a known location when the engine is turned off. Parking of the stepper motor is crucial and is annotated in the options menu by "Park". After the engine is shut off, the EMS keeps power to the main relay and then resets and parks the stepper motor. This takes about 30 seconds and is usually unnoticed by the user.

The other major IAC system is a pulse width duty cycle valve. This system regulates air bypass volume by utilizing a duty cycle controlled solenoid. This electric solenoid controls a normally closed air valve which blocks passage of air from the intake pipe to the intake manifold. Since this solenoid is incapable of flowing high air volume, a separate mechanical air valve is typically used to perform cold fast idle. With this type system, the EMS varies bypass airflow by changing the duty ratio of the command signal to the IAC valve. By increasing the duty ratio, the EMS holds the air bypass valve open longer, causing an increase in idle speed.

The advantage of this type of IAC system is that it does not need to park and because it does not take steps, you always know where the valve is. The disadvantage of this type of IAC system is that power is required to maintain idle unlike the stepper motor type. Pulse width idle air control systems also require specific frequencies to operate at. This frequency is defined in the EMS software but if not tuned right, they can be noisy.

Tuning Idle

The first step before tuning the IAC system is to determine the direction of the motor. The language of the IAC motor is in percentage. This is not percent open or percent of airflow, it is rather the full-scale percentage of the motor where 100% may be fully closed or fully open. Do not assume that a larger idle percent gives a higher idle speed. Some factory units actually decrease engine speed as idle percentage increases. It is very easy to determine which way your specific IAC system works.

- Open AEMPro and connect to the EMS.
- Confirm that the throttle position is set properly (closed < 1%, WOT > 95%).
- Confirm the AFR or that the vehicle has sufficient fuel for idling and that the vehicle is in the normal operating temperature.
- Open Options/Idle Setup and set Idle Max to a conservative 3,000RPM and set Idle Min to 400RPM.
- Open Options/Idle Setup and set Idle Throttle to a conservative 5% and set Idle Throttle X to a conservative 7%.

These settings will activate the idle circuit whenever the engine RPM is below 3000 RPM and the throttle is below 5%. These settings are not drivable but they will allow the vehicle to idle on its own so you can begin tuning.

- Open Parameters/Idle and note the Idle Set %.
- Start the engine.
- Get the vehicle to idle. This may require creative throttle movements to stabilize the idle until it catches itself.
- If the vehicle will not idle on it's own, open Options/Idle Setup and switch the Idle Set Invert.
- Once the engine is idling, do not depress the throttle and note the Idle Set % in parameters.
- Open Idle/Idle Coolant table. Change these values and note if the RPM rises or falls.
- Open Options/Idle Setup and change the Idle Throttle to 3%.
- Open Options/Idle Setup and change the Idle Throttle to 3%.
- Shut off the engine.

Now that you know how the IAC motor responds, you can start setting up the idle tables and idle options.

- Open Options/Idle Setup and set Idle Set +max to 0% and Idle Set +min to 0%.
- Start the engine.
- Open Idle/Idle Coolant table. Change these values to where the idle will rest at roughly 1100RPM.
- To allow closed loop idle feedback, open Options/Idle Setup and set Idle Set +max to a conservative 20% and Idle Set +min to a conservative -20%.
- Open Parameters/Idle and note the Idle Set % and Idle Target
- Unless the Idle Target is 1100RPM, the Idle Set should be close to, but not exactly, 0%.
- Give the motor a couple revs while keeping an eye on the Idle Set percentage.
- To narrow the idle range, set the Idle Set +max and Idle Set -min 5% greater than the maximum Idle Set percentages that is displayed in parameters.

User Definable Options for Idle

Idle >12Volt

Units: Idle %

Description: The amount of additional idle duty to add when the battery voltage is less than 12 volts. The number can be positive or negative depending on how the idle motor responds.

Typical Use: Helps in charging the battery and keeping the vehicle from stalling.

Idle Brown

Units: Voltage

Description: For stepper idle air control motors only. The position of the idle motor will be stored for a restart condition when the voltage drops below this value. A typical value is 9 volts. See Idle Brown Save.

Typical Use: This is used when there is not enough voltage to continue idling so the position of the idle motor sets up for a restart condition.

Idle Brown Save

Units: On/Off

Description: For stepper idle air control motors only. Allows the position of an idle stepper motor to be saved for quicker re-starts as the position is preserved and a reset will not be required. This function relies on permanent power. Turn "off" for pulse width modulated type idle air control motors and "on" for stepper type idle air control motors. See Idle Brown.

Typical Use: This is used when there is not enough voltage to continue idling so the position of the idle motor sets up for a restart condition.

Idle Hi

Units: Idle %

Description: Duty change required for the Idle Hi condition. See Idle Hi Add/Speed/Time.

Typical Use: Typically used for engine deceleration to help prevent engine stalling.

Idle Hi Add

Units: RPM

Description: Additional RPM to add to the Target Idle RPM when in the Idle Hi condition. See Idle Hi/Speed/Time.

Typical Use: Typically used for engine deceleration to help prevent engine stalling.

Idle Hi Speed

Units: MPH

Description: When above this speed, the high idle condition will be maintained indefinitely. The vehicle speed sensor (VSS) must be set up for this function to work. See Idle Hi Add/Time.

Typical Use: Typically used for engine deceleration to help prevent engine stalling.

Idle Hi Time

Units: Seconds

Description: Counter limits how long the Idle Hi conditions will be met once the idle conditions are met. See Idle Hi/Add/Speed.

Typical Use: Typically used for engine deceleration to help prevent engine stalling.

Idle Jack

Units: Idle %

Description: Amount of extra duty required to maintain the existing target RPM when the A/C compressor is enabled. The value can be positive or negative depending on how the idle air control motor responds. A typical value is (+/-) 10.

Typical Use: Used to encourage a stable idle when the A/C control is switched on.

Idle Max

Units: RPM

Description: Maximum RPM threshold for closed loop idle feedback. A typical value is 1700 RPM.

Typical Use: Stalling can occur if this RPM value is too high. This stalling is typically caused from driving slow enough to never exit the closed loop idle condition. The idle air control motor will completely close in attempt to bring the idle to the target value and cannot react and open fast enough if the user lets off on the throttle for an idle state. A steady "open loop" high idle can occur if this RPM value is too low. This is caused from the base idle speed (idle coolant table) never dropping below the idle max condition. The target idle will not be reached because the feedback control will never be met.

Idle Min

Units: RPM

Description: Minimum RPM for closed loop idle feedback. The lowest idle speed possible that should mimic the Crank Exit RPM. A typical value is 400 RPM.

Typical Use: If this RPM were smaller than the Crank Exit RPM, the idle air control motor would open during long cranks increasing air to the engine with no compensator for fuel. Open loop idling can occur if this value is too large where the idle air control motor does not respond. If the engine speed goes below this value, idling will be solely dependant on the ADV (Comp) and Fuel Pulse parameters.

saved for quicker re-starts as the position is preserved and a reset will not be required. This function relies on permanent power. Turn "off" for pulse width modulated type idle air control motors and "on" for stepper type idle air control motors. See Idle Brown.

Typical Use: This is used when there is not enough voltage to continue idling so the position of the idle motor sets up for a restart condition.

Idle Park

Units: Idle %

Description: For stepper idle air control motors only. User defined position to park an idle stepper motor for an easy restart condition. See Idle Park and Idle Park Stopped

Typical Use: If this value causes the stepper motor to open too much, the engine may not start from a lean condition. If this value causes the stepper motor to close too much, the engine may flood.

Idle Park Stopped

Units: On/Off

Description: For stepper idle air control motors only. Stops the idle position and resets to the Idle Park % position when the key is turned off.

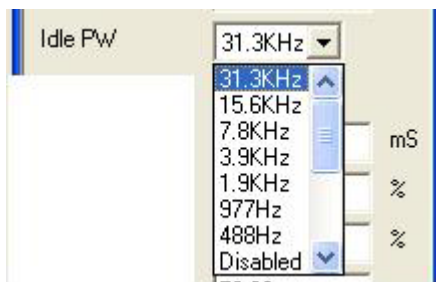
Typical Use: Enables a stepper motor to park and be controlled for specific idle functions.

Idle PW

Units: Hz

Description: For pulse width idle air control motors only. The input number equates to a specific frequency shown below for an idle pulse width motor.

This menu can be found under Idle | Advanced Idle | Options-Advanced PW



Typical Use: If the idle air control motor is loud this frequency value needs to be changed

Idle Pwr save

Units: On/Off

Description: For stepper idle air control motors only. Reduces current and prevents overheating for poor quality stepper motors. Off is typical.

Typical Use: Only used for poor quality stepper motors to reduce current and prevent overheating.

Idle R/S Key on

Units: On/Off

Description: For stepper idle air control motors only. Allows an idle stepper motor to reset to the Idle Park % for start up

Typical Use: Roughly 10 seconds is required from the time the ignition is turned "on" and the motor is cranked.

Idle R/S Rate

Units: mS

Description: For stepper idle air control motors only. User defined amount of time a stepper motor will take to make a step while in the reset function. A typical value is 8 milliseconds.

Typical Use: Used to setup and match a specific stepper motor response time.

Idle R/S stop

Units: On/Off

Description: For stepper idle air control motors only. When the ignition key is turned off and the Main Relay function is active, this allows a stepper motor to reset to the Idle Park % position.

Typical Use: The function allows the end user to exit the vehicle while the stepper motor resets itself.

Idle R/S TP

Units: On/Off

Description: For stepper idle air control motors only. Allows the idle stepper motor to re-start when above the Idle Max at a determined throttle position. See Idle R/S TP Off and On.

Typical Use: Used to allow a stable reentry into an idle condition.

Idle R/S TP Off

Units: Throttle %

Description: For stepper idle air control motors only. When the TPS is operating under this value, the idle stepper motor will not reset. Used in conjunction with Idle R/S TP and should be lower than Idle R/S TP On. A typical value is 80.

Typical Use: Used to allow a stable reentry into an idle condition.

Idle R/S TP On

Units: Throttle %

Description: For stepper idle air control motors only. When the TPS is operating above this value, an idle stepper motor will reset. Used in conjunction with Idle R/S TP and should be higher than Idle R/S TP Off.

A typical value is 90.

Typical Use: Used to allow a stable reentry into an idle condition.

Idle Rate

Units: mS

Description: Update rate for the output drive to an idle air control motor. For stepper motor idle air control motors, a typical value is between 4-30mS. For pulse width idle air control motors, the value should be the same as the drive frequency set in Idle PW and Idle PW*256. A typical value is 16mS.

Typical Use: This is how fast the idle air control motor makes a change from the feedback supplied. If this rate is too fast, the under damped idle will constantly overshoot the target value and idle sporadically. If this rate is too slow, the over damped idle may stall from many transient responses.

Idle Set +max

Units: Idle %

Description: Maximum air bypass percentage allowed maintaining target idle. See Idle Set -min. A typical value is 15.

Typical Use: Before tuning the idle option, this value may need to be large in order to stabilize idle for normal tuning. When tuning idle, it is a good idea to narrow the idle set range to eliminate unwanted idle changes.

Idle Set Band-

Units: RPM

Description: Disables idle correction below the target idle speed. See Idle Set Band+. A typical value is -25.

Typical Use: This function is very useful if exact idle speeds are not crucial, but reasonable stable speeds are. If this value is too large, stalling may occur due to low idle speeds.

Idle Set Band+

Units: RPM

Description: Disables idle correction above the target idle speed. See Idle Set Band-. A typical value is 25.

Typical Use: This function is very useful if exact idle speeds are not crucial, but reasonable stable speeds are. If this value is too large, high idling may occur due to open loop feedback.

Idle Set Invert

Units: On/Off

Description: Inverts the direction that the idle motor takes to achieve the target idle.

Typical Use: Used in instances when the idle motor responds in the opposite direction to reach the target idle. If the idle set parameter is moving far away from 0, this function needs to be switched to compensate for your particular idle air control motor.

Idle Set -min

Units: Idle %

Description: Minimum air bypass percentage allowed maintaining target idle. See Idle Set +min. A typical value is -15.

Typical Use: Before tuning the idle option, this value may need to be a large negative number in order to stabilize idle for normal tuning. When tuning idle, it is a good idea to narrow the idle set range to eliminate unwanted idle changes.

Idle Set Rate

Units: mS

Description: Idle air control feedback time base. Time allowed for an idle air control motor to respond and make decisions for idle feedback.

Typical Use: This function determines how often the engine speed is referenced for closed loop feedback in order to make adjustments and maintain the idle target. Making the time smaller, speeds decision-making but may cause the idle control to "hunt". Increase this number to the largest value that can still accurately control the idle. If hunting or surging occurs increase this number. If the idle motor responds slowly to RPM variations off the idle target, then decrease this number. A typical value is 200.

Idle Step Clock

Units: On/Off

Description: For stepper idle air control motors only. Allows the direction of a stepper motor to be reversed for raising and lowering the idle rpm.

Typical Use: This function is used to switch the direction of a stepper motor to clockwise or counterclockwise depending on how the stepper motor responds.

Idle Step#1/2

Units: On/Off

Description: For stepper idle air control motors only. Turn “on” when outputting from this function. Turn “off” for user-defined control.

Typical Use: If this function is not used to control an idle stepper motor, it should be turned off to run as a low side driver if applicable.

Idle Step#3/4

Units: On/Off

Description: For stepper idle air control motors only. Turn “on” when outputting from this function. Turn “off” for user-defined control.

Typical Use: If this function is not used to control an idle stepper motor, it should be turned off to run as a low side driver if applicable.

Idle Step#5/6

Units: On/Off

Description: For stepper idle air control motors only. Turn “on” when outputting from this function. Turn “off” for user-defined control.

Typical Use: If this function is not used to control an idle stepper motor, it should be turned off to run as a low side driver if applicable.

Idle Step#7/8

Units: On/Off

Description: For stepper idle air control motors only. Turn “on” when outputting from this function. Turn “off” for user-defined control.

Typical Use: If this function is not used to control an idle stepper motor, it should be turned off to run as a low side driver if applicable.

Idle Throttle

Units: Throttle %

Description: Throttle dependant idle feedback. Idle feedback is active when throttle percentage is below this number. A typical value is 3.

Typical Use: In order for idle feedback to be active, make sure this value is larger than your throttle percent parameter during an idle state.

Idle Throttle X

Units: Throttle %

Description: Exit of throttle dependent idle feedback. Idle feedback is disabled when the throttle percentage is above this number. This value also determines the re-instatement of idle feedback. This number should be larger than the Idle Throttle number. A typical value is 5.

Typical Use: This value is crucial in determining and allowing an idle state, but to prevent tip-in stalling, this value should be as close to the Idle Throttle number as possible.

IdleX/X I

Units: Amps

Description: Current setting for a specific motor which must always be set. Typical values are 1.5 - 2 Amps.

Typical Use: When used for a stepper motor, 2 Amps is typical. When idle power save mode is entered, the current here is decreased. When used for an intake air bypass system, 1.5 Amps is typical.

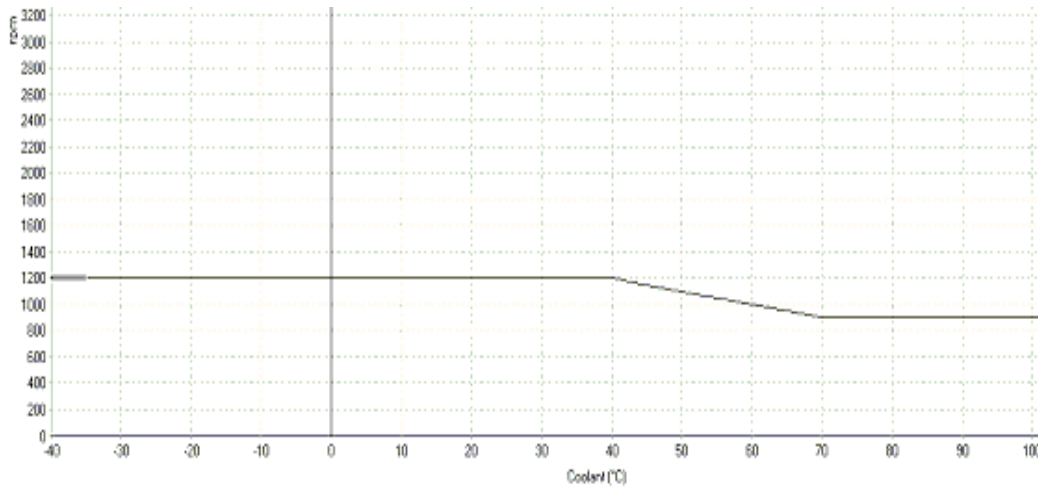
2-D Tables for Idle

Idle Target vs Cool Table

Units: Target Idle RPM vs. Coolant Temperature

Description: Coolant dependant base table for target idle RPM.

Typical Use: This table determines the target idle speed at specific engine coolant temperatures. The RPM values should be greater at cooler temperatures to help stabilize idle and encourage the engine to warm up faster. During a very cold start up, 1500RPM is typical. This table, typically, moves downwards around 850RPM at a normal operating temperature.

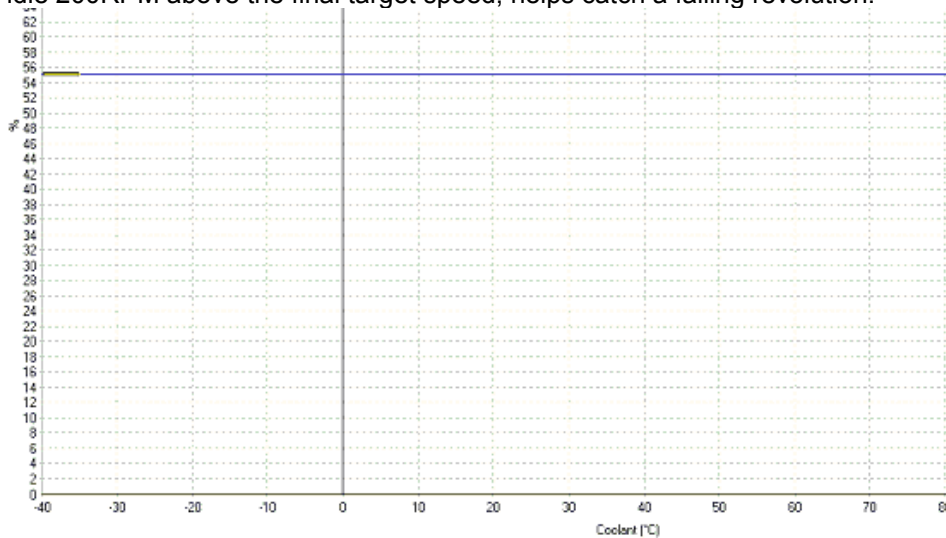


Idle Base Table

Units: Idle % vs. Coolant Temperature

Description: Base bypass idle air percentage used to start the target idle descend. Typical values are 50%, however, this varies greatly and depends on the idle control motor used.

Typical Use: When setting the idle conditions for the first time, the idle set + and idle set- options should be set to zero. This table determines the air bypass necessary to obtain a steady idle. Setting this table to idle 200RPM above the final target speed, helps catch a falling revolution.

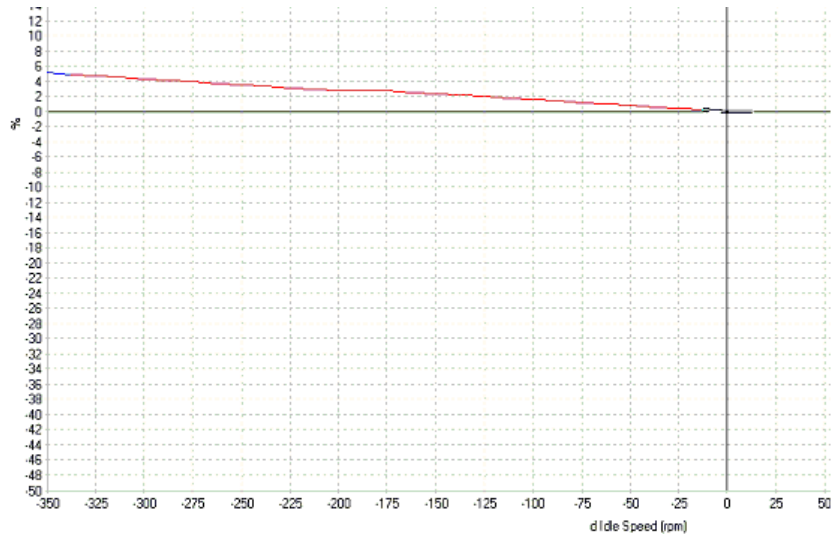


Idle Fuel Table

Units: Fuel % vs. Delta Idle Speed (Actual RPM - Target RPM)

Description: Introduces the ability to tune a separate fuel table near the target idle to help maintain a specific air fuel ratio and a steady idle.

Typical Use: Because there are many idle variables, this table should be set up at the end of a tuning session. If necessary, this table is used when large overlap conditions are present due to large cams or aggressive intake porting.

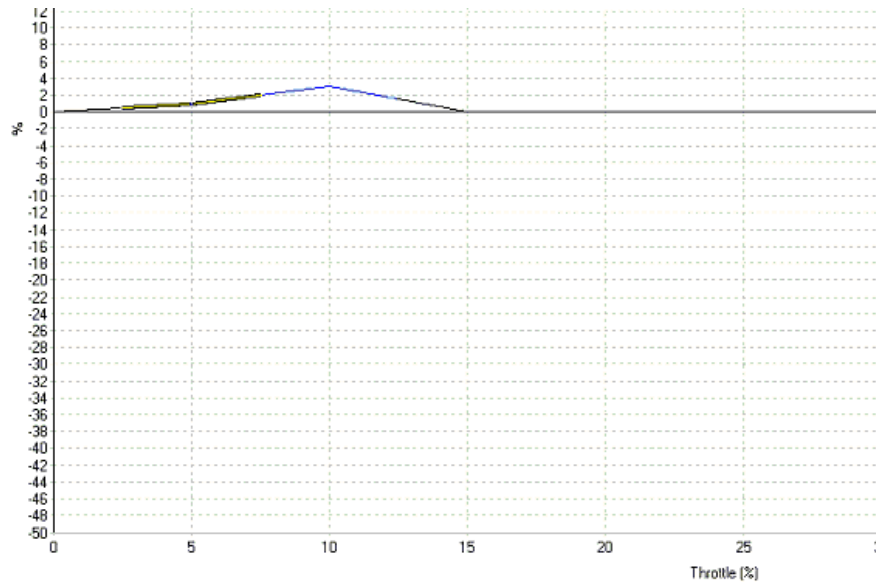


Idle Set TP Table

Units: Idle % vs. Throttle %

Description: Increases the idle percentage based on throttle position to prevent stalling. Only used when the throttle percentage is below the Idle Throttle X. This table works in conjunction with the Idle Speed TP Table.

Typical Use: This table is useful while creeping in traffic where a very small throttle change could cause the idle air control motor to close and stall the motor. By increasing the idle % at low throttle percentages, it will increase the target idle and keep the idle air control motor open.

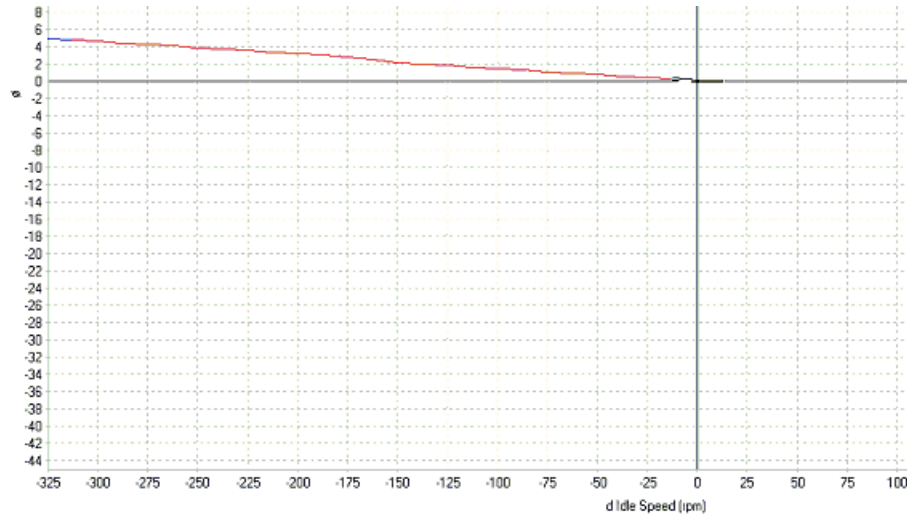


Idle Spark Table

Units: Ignition Timing Degrees vs. Delta Idle Speed (Actual RPM - Target RPM)

Description: Introduces the ability to tune ignition timing near the target idle to help maintain a steady idle.

Typical Use: Because there are many idle variables, this table should be set up at the end of a tuning session. If necessary, this table is used to help prevent stalling by encouraging a higher idle.

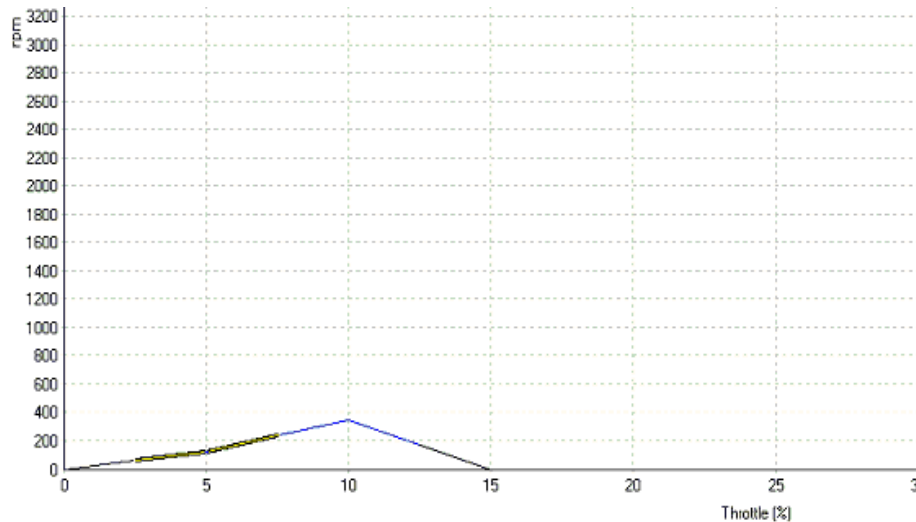


Idle Speed TP Table

Units: RPM vs. Throttle %

Description: Increases the target idle speed based on throttle position to prevent stalling. Only used when the throttle percentage is below the Idle Throttle X. This table works in conjunction with the Idle Set TP Table.

Typical Use: This table is useful while creeping in traffic where a very small throttle change could cause the idle air control motor to close and stall the motor. By increasing the RPM at low throttle percentages, it will increase the target idle and keep the idle air control motor open.

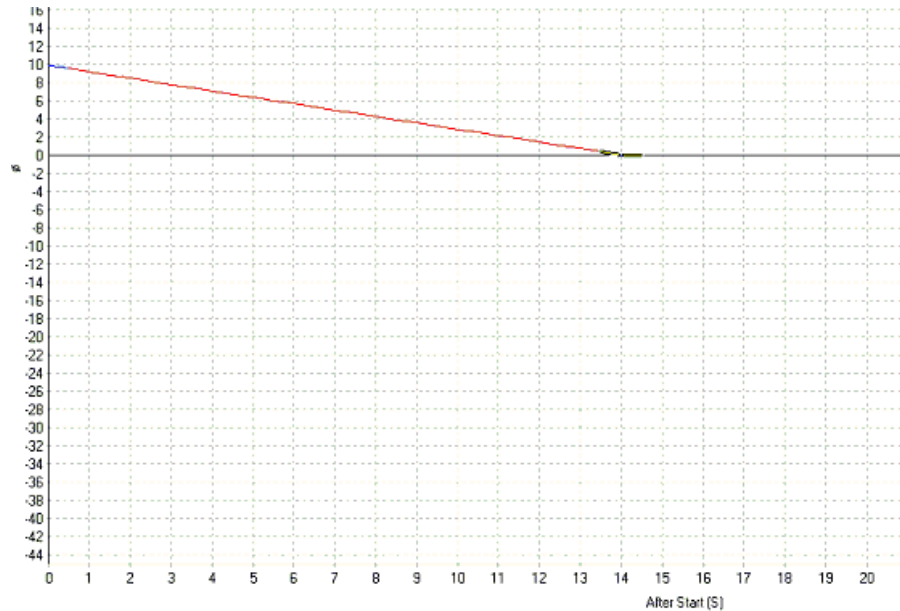


Idle Start Advance Table

Units: Ignition Timing Degrees vs. After Start Time

Description: Introduces the ability to tune ignition timing based on the time after the engine begins to crank.

Typical Use: Advancing the timing typically helps the engine start and run. Some may elect to then retard the timing to add heat to the engine to help warm up and light off the O2 sensor and/or the catalytic converter.

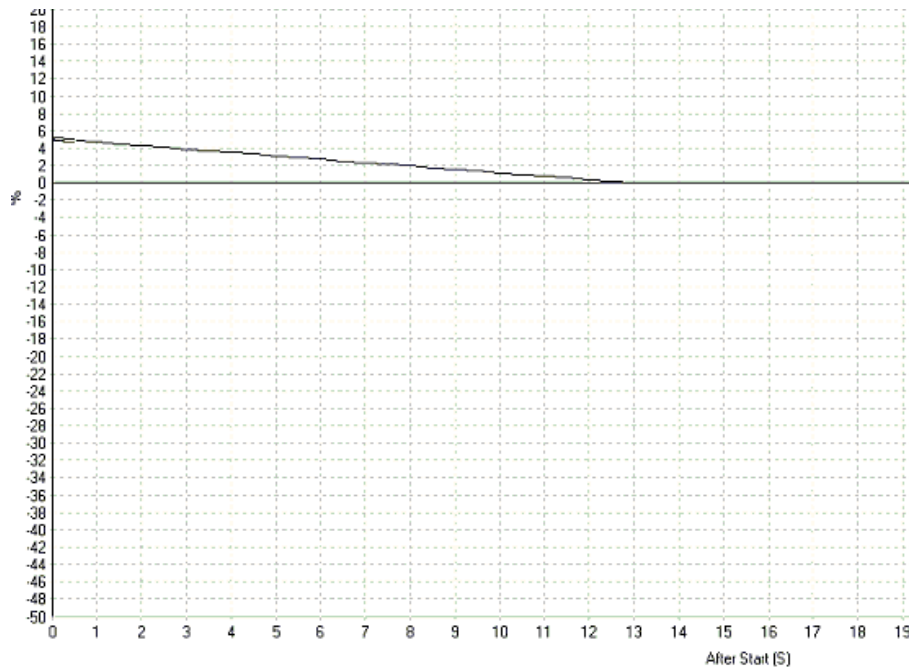


Idle Start Off Table

Units: Idle % vs. After Start Time

Description: Increases the idle percentage based on the time after the engine begins to crank

Typical Use: Used to increase idle % and encourage the engine to start and warm up quicker.

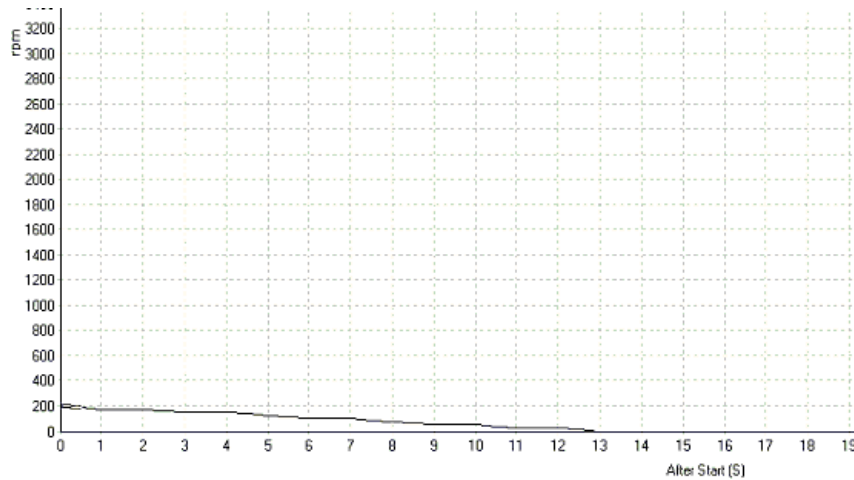


Idle Start Speed Table

Units: RPM vs. After Start Time

Description: Increases the idle target RPM based on the time after the engine begins to crank.

Typical Use: Used to increase RPM and encourage the engine to start and warm up quicker.

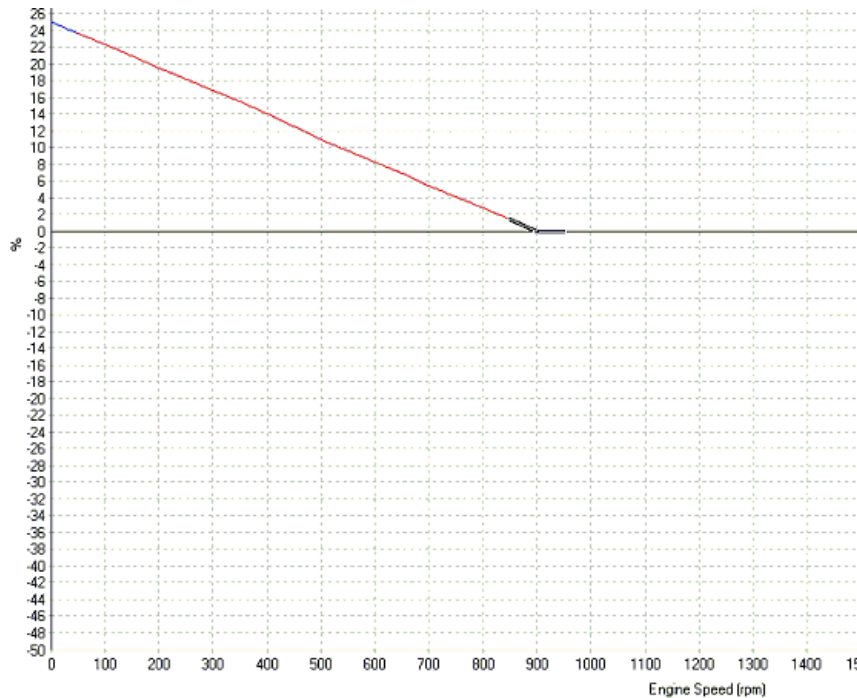


Idle vs. Speed Table

Units: Idle % vs. RPM

Description: Anti-stall condition which opens the idle control motor to bypass additional air to encourage a higher engine speed.

Typical Use: At 0RPM these values typically move from (+/-) 10% to the target idle speed at 0%. Increase these values if this does not catch the engine quickly enough. Too aggressive of a slope may also cause stalling.



Parameters (can be viewed or logged)

d Idle Speed

Units: RPM

Description: RPM value above or below the idle target value.

Hidle count

Units: Seconds

Description: Time after the Idle Hi conditions are met to drop back into the normal idle conditions.

Idle

Units: Idle %

Description: Final compensated idle air bypass percentage.

Idle Counter

Units: Idle %

Description: AEM idle percentage diagnostic.

Idle Fuel

Units: Idle %

Description: Additional amount of fuel percentage added or subtracted from the base fuel map for an idle condition.

Idle Hi Offset

Units: Idle %

Description: The additional idle percentage added when using the Idle Hi functions.

Idle Hi Speed

Units: RPM

Description: The additional RPM added when using the Idle Hi functions.

Idle Mod

Units: Idle %

Description: The amount of idle air bypass percentage from trim control.

Idle R/S count

Units: Raw

Description: The time for resetting the stepper idle air control motor.

Idle rate count

Units: Raw

Description: The amount of time it takes to make each step for a stepper motor.

Idle set

Units: Idle %

Description: The idle percentage above or below the target idle. Zero percent would represent no correction to the IAC motor to achieve the target idle.

Idle Spark

Units: Ignition Timing Degrees

Description: Additional amount of ignition timing advanced or retarded from the base ignition map for an idle condition.

Idle speed

Units: Idle %

Description: AEM idle percentage diagnostic.

Idle Start Speed

Units: RPM

Description: The additional amount of RPM added after starting the vehicle.

Idle Start Off

Units: Idle %

Description: The additional amount of idle air bypass percentage added after starting the vehicle.

Idle Target

Units: RPM

Description: This is the final idle target RPM value that the IAC motor is attempting to achieve after all idle compensators.

Idle TPS

Units: Idle %

Description: The additional amount of idle air bypass for specific TPS ranges.

Stepper RD

Units: Raw

Description: AEM idle stepper motor diagnostic.

Stepper WT

Units: Raw

Description: AEM idle stepper motor diagnostic.

Troubleshooting Idle

The engine idles high and will not settle

- Adjust the Idle Base Table to output a lower idle speed and allow closed loop idle feedback.
- Raise the Idle Max to a higher RPM value to allow closed loop idle feedback
- Lower the Idle Base Speed to the target RPM.

The engine stalls while stationary

- Adjust the Idle Base Table to output a higher idle speed.
- Adjust the Fuel Map at an idle condition to allow a stable idle.
- Adjust the Idle vs. Speed Table

The engine stalls while driving slow or moving in traffic

- Lower the Idle Max RPM value while still maintaining closed loop idle feedback.
- Use the Idle Speed TP and Idle Set TP Tables to increase the idle target value while in an idle condition.

The engine surges during idle

- Increase the Idle Set Rate.
- Adjust fuel in the Fuel Map at an idle condition.
- Adjust the Idle vs. Speed Table

There is an irritating noise coming from the pulse width IAC valve.

- Change the frequency of the IAC motor using Idle PW.

Accel/Decel Functions

The AEM EMS has a traditional accelerator pump which consists of delta-throttle position (dTP) and delta-load (dMAP) components. These both work on similar principles. The idea being that a rapid change of pressure in the intake system requires a change in fuel requirements, beyond that dictated by a simple air-fuel ratio calculation. The primary reason for this is the time lag for the fuel flow into the air stream at the injector and the fuel flow past the inlet valve. Chiefly, this is due to the liquid fuel that is on the intake track walls which travels much slower than the fuel vapor and small droplets of fuel being carried by the air stream. For this same reason, there is a “decel pump”, which, acts opposite as the accel pump.

Accel Pump

By measuring the dTP, you can judge how much extra fuel would be required. Alternately, if the dTP does not give a good indication of the change in inlet pressure, if you have huge throttle plates or a positive displacement supercharger, you may need to use dMAP directly.

Throttle Based Accel Pump

The operating principle is pretty standard. When the throttle is moved, the dTP value is calculated. It gives a number proportional to the rate of change of the throttle. If this value is above a user specified threshold (Accel TP Trig) then the acceleration pump is enabled. But, since the TPS signal is usually noisy, the accel pump would be triggering all the time. So we need to filter it before the threshold test is performed. The filter specification can be set with the “TPS Filter” value.

Once a dTP value is generated, the corresponding accel pump size is looked up from the “dTP Accel Table”. This table gives a % accel pump size, versus the dTP value. This % size is relative to the current injector pulse width (PW). So if the current PW is 1,400 uS (1.4mS) and the % value was 75%, the base accel pump size would be $75\% * 1.4\text{mS} = 1.05\text{mS}$.

Once a base accel pump size is generated, it is immediately multiplied by the “Accel Mod Table”. This is a TPS based table and serves to scale the output based on the throttle position when the accel pump was activated. This table usually starts at 100% and decreases to 0% at high throttle value. This yields an accel pump value that varies by throttle angle and is usually large for throttle movements near closed throttle and small for throttle movements near WOT.

Next, it is multiplied by the “TPS Accel Table” which is the RPM based correction for the dTP component. This table usually starts at 100% and then decreases to a smaller value (sometimes 0%) at RPM values. This makes sense because the fuel delay is smaller at high port velocities; hence the accel pump can be smaller.

To recap what’s happened, a filtered throttle position change has been detected and from this value, a base % accel pump was determined. Then it was corrected for TPS and RPM.

Now, it is checked against the user option “Accel Limit”. If it is larger than this value, then it is reset to this value. This percentage is multiplied by your current fuel pulse width, giving a time in uS, and is applied as the starting value for your accelerator pump.

Once the pump is applied, the EMS decreases the pump size to zero (assuming there are no more accel pump actions in the meantime). This is controlled with the “Accel Decay” option. On a fixed time basis, the EMS comes back, and multiplies the current value of the pump by the decay percentage, yielding the new, decayed pump. Thus, a larger value makes the pump decay slower.

MAP Based Accel Pump

The dMAP pump works on exactly the same principle as the dTP pump with a exception. There is no dMAP table. This value is directly calculated from the change in the load, based on full scale for the load axis. For example, if you were at 10% load and then opened the throttle and saw 45% load, the dMAP is 35%.

Decel “Pump” and Decel Fuel Cut Off

The Decel “Pump” (-dTP) works in exactly the same way as the +dTP based accel pump operates. Its purpose is to combat the enrichment that occurs when the mass of the fuel being delivered decreases suddenly. The settings are the same as the +dTP except where a -dTP specific setting is available.

Decel Fuel Cut Off (DFCO)

This is the most common type of fuel cut under deceleration. The basic principle is that when above a specific RPM, but at very low throttle and load, it is safe to completely cut fuel. This helps fuel economy and reduces emissions.

The engine RPM threshold is set in the “*DFCO Speed*” option. The load threshold is set with the “*DFCO Load*” option. The throttle position is set with the “*DFCO Throttle*” option.

3-D Tables for the Accel/Decel Pump

Accel mod Table

Units: Accel Fuel Mult vs TPS

Description: Throttle dependant scalar for the dTP component of accel/decel fuel

Load Accel Table

Units: Accel Fuel Mult vs RPM

Description: RPM dependant scalar for the +load component of accel fuel

TPS Accel Table

Units: Accel Fuel Mult vs RPM

Description: RPM dependant scalar for the +dTP component of accel fuel

dTP Accel Table

Units: Accel Fuel vs dTP

Description: Initial or base value for the throttle component of accel/decel fuel

TPS Decel Table

Units: decel Fuel Mult vs RPM

Description: RPM dependant scalar for the -dTP component of decel fuel

User Definable Options for the Accel/Decel Pump

Accel Decay

Units: %

Description: Determines the rate at which the accel fuel goes away. Actual formula used is current accel fuel * this number, each engine revolution. A larger number makes the accel fuel stay longer. Typical value is 75%

Accel Limit

Units: %

Description: Maximum accel fuel allowed to be added. The software clamps the accel component to this value no matter how high the calculated value is.

Accel MAP Trig

Units: %

Description: When the change in MAP (dMAP) exceeds this value, accel fuel can be added. This acts as a minimum load change threshold for accel fuel.

Accel TP Trig

Units: %

Description: When the change in TP (dTP) exceeds this value, accel fuel can be added. This acts as a minimum TPS change threshold for accel fuel.

Decel Decay

Units: %

Description: Determines the rate at which the decel fuel comes back. Actual formula used is current decel fuel * this number, each engine revolution. A larger number makes the decel fuel removed leave faster. Typical is 50%

Decel TP Trig

Units: %

Description: This is the -dTP threshold at which to trigger decel fuel

DFCO Load

Units: %

Description: This is the load at which when below to trigger decel fuel

DFCO Speed

Units: %

Description: This is the RPM at which when above to trigger decel fuel

TPS Filter

Units: %

Description: Used for accel/decel. Filters the TPS input and the effect can be viewed in TPS filtered. It reduces the fault triggering for very sensitive throttle changes. A value of 0% completely kills the accel pump function. A value of 100% is essential no filter and creates a hyper/useless pump. A typical value is 5%-30%. You set this value while the engine is off and watching the +dThrottle and +dZThrottle parameters.

PARAMETERS (can be viewed or logged)

+dThrottle

Units: Throttle Percentage

Description: The current positive (opening) delta throttle value.

+dZThrottle

Units: Throttle Percentage

Description: The latched positive delta throttle value for the current accel pump application. It saves the max +dThrottle value so its easier to tune.

-dThrottle

Units: Throttle Percentage

Description: The current negative (closing) delta throttle value.

-dZThrottle

Units: Throttle Percentage

Description: The latched negative (closing throttle) delta throttle value for the current decel pump application. It saves the max -dThrottle value so its easier to tune.

Accel Fuel

Units: uS of Injection PW

Description: The total current size of the accel pump.

Accel Mod

Units: Overall Multiplier of Accel Pump Size, In Percent

Description: The current modifiers for the accel pump (temperature, throttle, RPM etc) 100% means you get the full pump size.

Accel Trig

Units: Counts

Description: This is the number of times that the accel pump has been triggered. If this increases by more than 10 at a time, change the TPS Filter.

Accel Fuel +Max

Units: uS of Injection PW

Description: The maximum size allowed for the Accel pump based on the current injector PW and the option Accel Limit (%)

Accel Fuel -Max

Units: uS of Injection PW

Description: The maximum size allowed for the Decel pump based on the current injector PW and the option Accel Limit (%) This name is misleading. Think if it as Decel Fuel -Max

delta MAP

Units: % Load

Description: The current value of dMAP, AKA the seed value for the Delta MAP based portion of the accel pump.

Boost Control Configuration

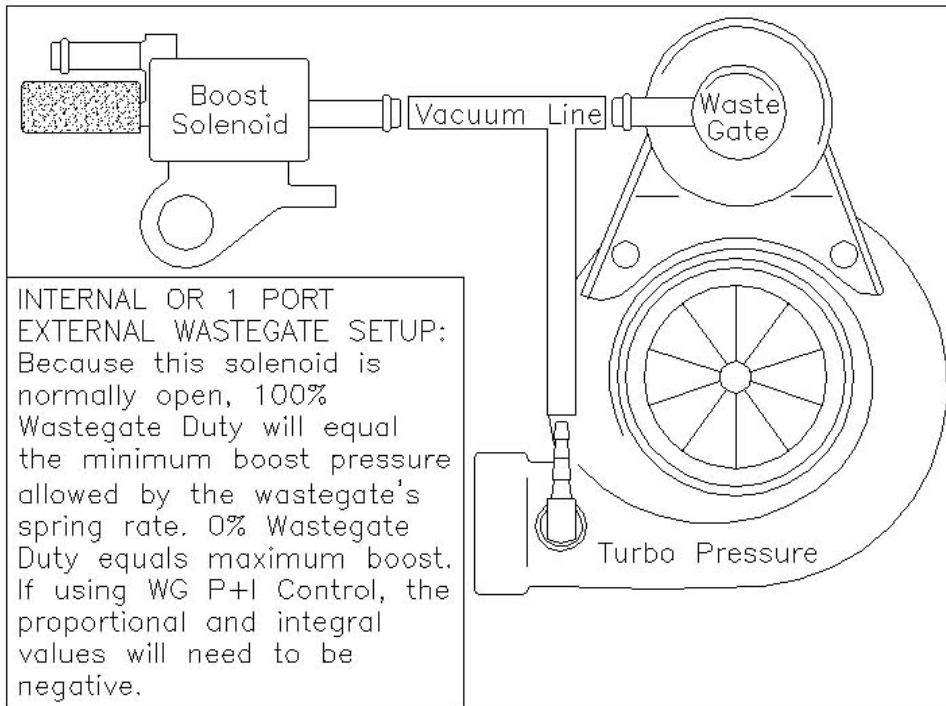
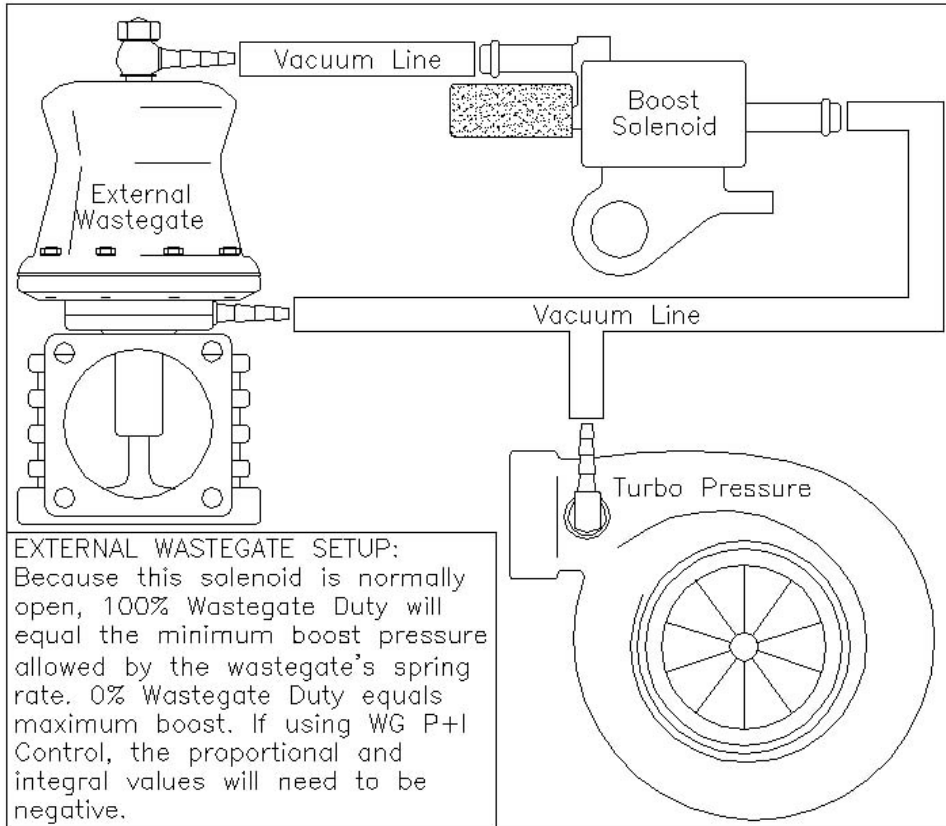
Warning: Use extreme caution when tuning Boost control, over boost situations can cause severe engine damage.

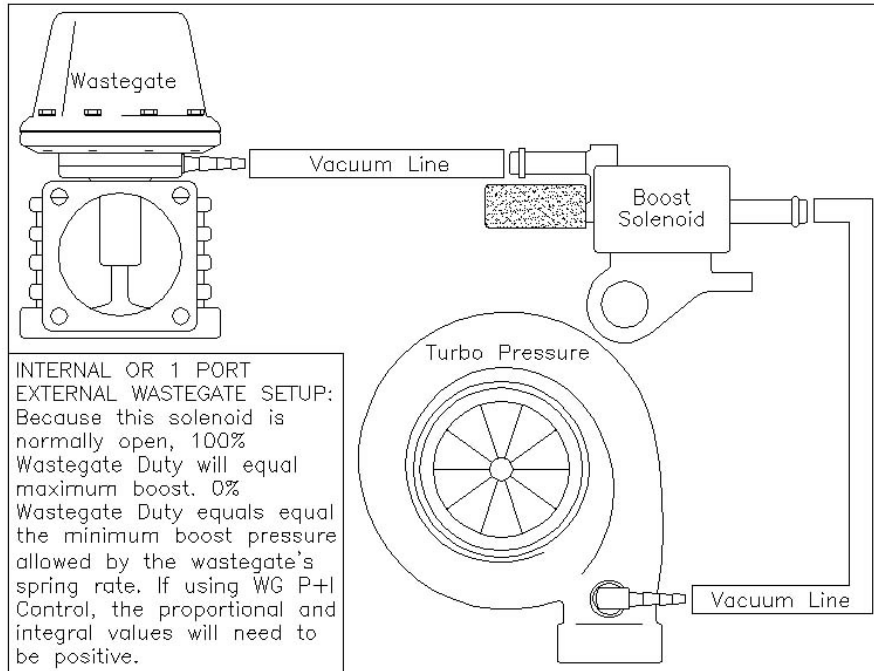
The AEM EMS has a very comprehensive and flexible boost control circuit. Using a pulse width actuated solenoid, boost can be controlled by vehicle speed, throttle position against rpm, and a switch input for low and high settings. AEM recommends a 3-way GM solenoid (PN 1997152).

The first thing to do is determine what frequency the solenoid needs to be operated at. This information is typically provided by the manufacturer of the part, if you are using a plug n play with a factory boost control solenoid, this comes pre-configured by AEM.

The PW2 output pin needs to be determined when installing a boost solenoid. Print the pin out sheet for the specific EMS used if unsure of the PW2 pin. This information can be found on the AEM EMS forum (www.aempower.com). There are two wire connections for a boost solenoid and since it is a coil they will have no polarity. One wire connects to 12 volt switched power and the other will connect to the PW2 output on the EMS.

The specific waste gate type that will be used will also need to be determined when installing the boost solenoid. Illustrated below are typical ways of routing the boost (vacuum) lines with three different waste gate types.





Tuning Boost Control

The first step before tuning the boost solenoid is to determine if duty takes away boost pressure or makes boost pressure. To determine this, find the particular wastegate setup being used from the diagrams above. The language of the boost solenoid is in percent duty cycle. This is not percent open or percent of airflow, it is rather the full-scale percentage of the solenoid where 100% is fully closed or fully open depending on the solenoid used. The 3 way GM solenoid is a normally open solenoid so 100% duty cycle is fully closed.

- Open AEMPro and connect to the EMS
- Confirm that the throttle position is set properly (closed < 1%, WOT > 95%)
- Confirm the AFR or that the vehicle has sufficient fuel for boosting.
- Open Options/Boost Control and set WG/Idle PW TPS to 10%.
- If using the 3 way GM solenoid, set WG PW to 3, WG PW*256 to On, WG Duty max to 84.38%, and WG Duty min to 10.16%.
- Set the boosted section of the Wastegate Duty Map to 50%.
- Set your boost target in the Boost Target VSS table and/or the Boost Target Thrott map.
- Log your Boost and WG parameters, ie: Boost Target, WG Duty Out, etc.
- From the log, the proper open loop wastegate duty can be determined.
- After the appropriate wastegate duty is found, the wastegate feedback (error control and/or P+I) can be enabled.

The tuning procedure for boost control can be quite tedious. One approach is to use a technique known as the Ziegler Nichols Tuning Method. The Ziegler Nichols closed loop method uses Proportional or P + I control and should produce tuning parameters, which will obtain quarter wave decay.

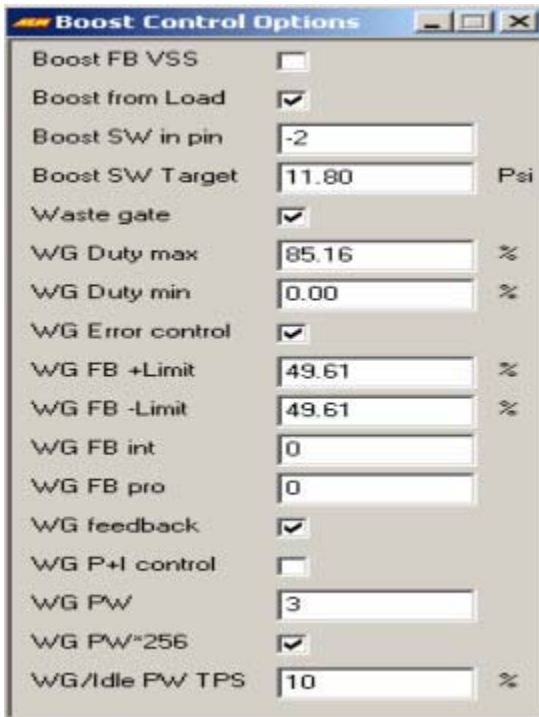
- 1) Use the proportional control (WG FB pro) by itself and set the integral time constant (WG FB int) to zero.
- 2) Log the parameters Engine Load and WG Duty Out.
- 3) Increase the value of the proportional gain until the point of instability or a sustained oscillation is reached.
- 4) From here, the ultimate proportional gain (G_u) is found.
- 5) From the log, measure the period of oscillation from peak to peak, in seconds, to obtain the critical time constant or ultimate period (P_u).
- 6) Once the values for G_u and P_u are obtained, the P + I parameters can be calculated from the following equations.

Proportional feedback only (WG FB int = 0)
 WG FB pro = 0.5 (G_u)

Proportional and Integral feedback
 WG FB pro = 0.45 (G_u)
 WG FB int = (P_u)/1.2

Note that these values are not optimal values and additional fine tuning may be required to obtain the best boost control performance.

User Definable Options for Boost Control



Boost FB VSS

Units: On/Off

Description: Activates the boost control against vehicle speed (see Boost Target VSS Table).

Typical Use: By default, the boost target is associated with the Boost target Thrott Map. This function is used to enable boost pressure to be vehicle speed based opposed to TPS dependant.

Boost from Load

Units: On/Off

Description: Determines if the boost control target is based on the load value or the MAP value.

Typical Use: On MAF sensor equipped vehicles; load is produced from the mass airflow sensor opposed to a MAP sensor. Switch this function "On" if controlling boost from a MAF sensor. Switch this function "Off" if targeting boost control from a MAP sensor and using a MAF sensor as the load input. If a MAF sensor is not used and/or not running boost, turn this function "Off."

Boost SW in pin

Units: Channel #

Description: Optional alternative boost level controlled from a switch input. Sets the channel location where this input is coming from on the EMS. See input pin descriptions to determine what number is to be entered.

Typical Use: Used to enable both street and race boost settings via a flip of a switch.

Boost SW Target

Units: Load

Description: This new boost target activates when using the Boost SW function.

Typical Use: Used to enable street and race boost settings via a flip of a switch.

Waste gate

Units: On/Off

Description: Switches the waste gate output on.

Typical Use: Once on, the waste gate operates from the duty tables without feedback unless "WG Feedback" is also on.

WG Duty max

Units: % Duty Cycle

Description: Waste gate feedback maximum range. This sets the maximum allowable duty output to the boost control solenoid, preventing overdrive of the solenoid.

Typical Use: Allows a narrow range of operation for precise boost control. Because certain solenoids will not function at specific duty cycles, manufacturers require limitations to be set. The 3 way solenoid from GM requires a maximum duty cycle of 85%.

WG Duty min

Units: % Duty Cycle

Description: Waste gate feedback maximum range. This sets the minimum allowable duty output to the boost control solenoid, preventing overdrive of the solenoid.

Typical Use: Allows a narrow range of operation for precise boost control. Because certain solenoids will not function at specific duty cycles, manufacturers require limitations to be set. The 3 way solenoid from GM requires a minimum duty cycle of 10%.

WG Error control

Units: On/Off

Description: Activates the Waste gate error function. Note: Both Boost Error control and Proportional and integral control can be used at the same time for extremely fine control, this must be set up carefully or the two feedback circuits can fight each other (see Boost Error Duty table)

Typical Use: Enables closed loop boost control feedback to be controlled by the Boost Error Duty table.

WG FB +Limit

Units: % Duty Cycle

Description: Sets the maximum feedback correction allowed in the positive duty direction.

Typical Use: Used to set correction limits and help stabilize boost. This function can help prevent overshooting.

WG FB -Limit

Units: % Duty Cycle

Description: Sets the maximum feedback correction allowed in the negative duty direction.

Typical Use: Used to set correction limits and help stabilize boost. This function can help prevent overshooting.

WG FB int

Units: Time Constant

Description: Integral control is implemented through the introduction of an integrator. Integral control is used to provide the required accuracy for the control system. This is used to fine tune the boost control at the target boost once the proportional has acted in getting close to the target. Note: start tuning the boost control feedback with this option at zero, until the proportional has you close to your target, then step this in slowly until you are holding the target boost.

Typical Use: When the WG Error Control is off and the Boost Error Duty table is not used, proportional and integral control is applicable.

WG FB pro

Units: Gain Multiplier

Description: Proportional control is a pure gain adjustment acting on the error signal to provide the driving input. It is used to adjust the speed of the system and reach the target boost quickly. The advantage of a proportional-only control is its simplicity. If boost offsets can be tolerated, the use of a proportional controller may be optimal. However, it will not eliminate the steady-state error that occurs after a set-point change or a sustained load disturbance. Note: When tuning the boost control and overshoot occurs, lower this number. If undershooting the target boost, raise this number.

Typical Use: When the WG Error Control is off and the Boost Error Duty table is not used, proportional and integral control is applicable.

WG feedback

Units: On/Off

Description: This turns the waste gate feedback output on. Once on, the "Boost Error Table" or WG P+I control can be active to modify the duty cycle based on the target boost.

Typical Use: Allows closed loop boost control feedback.

WG P+I control

Units: On/Off

Description: Switching this "On" enables the Proportional (P) and Integral (I) feedback control logic for boost control. When this is "Off", the Boost Error Table may be used to control boost. Note: this can be used with the Waste Gate FB error control.

Typical Use: When the WG Error Control is Off and the Boost Error Duty table is not used, proportional and integral control is applicable.

WG PW

Units: Hz

Description: This input number equates to a specific frequency for the pulse width boost solenoid (shown below). See WG PW*256.

0 = 31,300 Hz

1 = 15,600 Hz

2 = 7,800 Hz

3 = 3,900 Hz

4 = 1,900 Hz

5 = 977 Hz

6 = 488 Hz

7 = Disabled

Typical Use: If the boost solenoid is loud, this frequency value needs to be changed and is dependant on the WG PW*256. The 3 way solenoid from GM requires a frequency of roughly 20Hz.

WG PW*256

Units: On/Off

Description: This is a frequency multiplier used to extend the frequency range of the Boost control output. When switched on, the frequency numbers below holds true and are dependant on the WG PW value. When switched off, the WG PW value above holds true and the frequencies below are disabled. Here are the new frequencies when enabled:

0 = 122 Hz

1 = 61 Hz

2 = 30.5 Hz

3 = 15.3 Hz

4 = 7.6 Hz

5 = 3.8 Hz

6 = 1.9 Hz

7 = Disabled

Typical Use: If the boost solenoid is loud this multiplier may need to be switched but is also dependant on the WG PW. The 3 way solenoid from GM requires a frequency of roughly 20Hz.

WG/Idle PW TPS

Units: Throttle %

Description: This is only used if the idle control circuit is on the same control as the boost control, and sets the transition point from idle control and Waste Gate control. The AEM EMS has two paired PW outputs (PW 1 & 2, and PW 1i & 2i). For example, if you are using PW1 for idle control, and PW1i for boost control this option would need to be set. This throttle threshold is the switch point between these two functions. When throttle is above this value, the throttle generator is controlling boost. When throttle is below this value, the throttle generator is controlling idle.

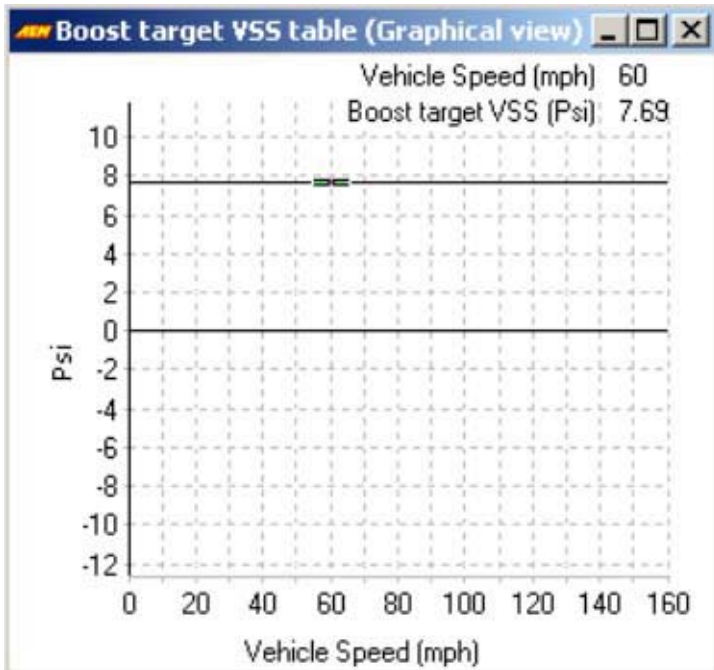
Typical Use: If not using the boost control function, set this to 100%. If not using an IAC motor, set this to 0%. A typical value is 5%.

2-D Tables for Boost Control**Boost target VSS table**

Units: Load vs. Vehicle Speed

Description: Vehicle speed dependant boost control. This table is the target boost against vehicle speed. Setting the boost values lower at lower vehicle speeds will help traction challenged vehicles achieve traction sooner. This table becomes active when the Boost FB VSS option is set to On. Note: When the Boost Switch input is being used, this table is over ridden by the Boost Switch Target.

Typical Use: This table is used as a traction control device by adjusting the boost target from vehicle speed.

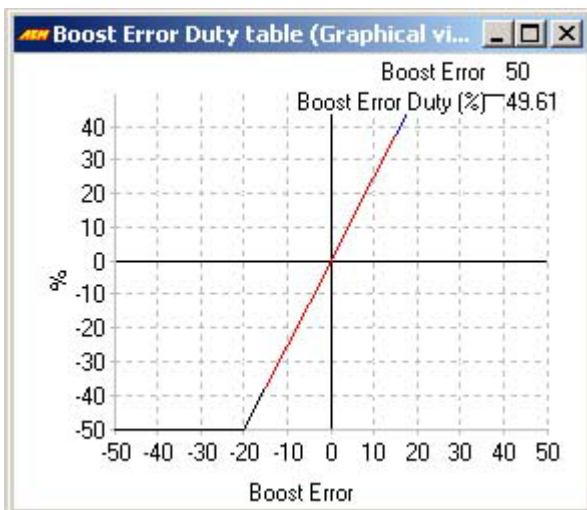


Boost Error Duty table

Units: % Duty Cycle vs. Boost Error

Description: The vertical line in the center of the table, at zero boost error, represents the boost target that the waste gate is trying to achieve. The direction of this curve is dependant of how the waste gate is configured. See the above waste gate diagrams.

Typical Use: This table is used to stabilize boost pressure.

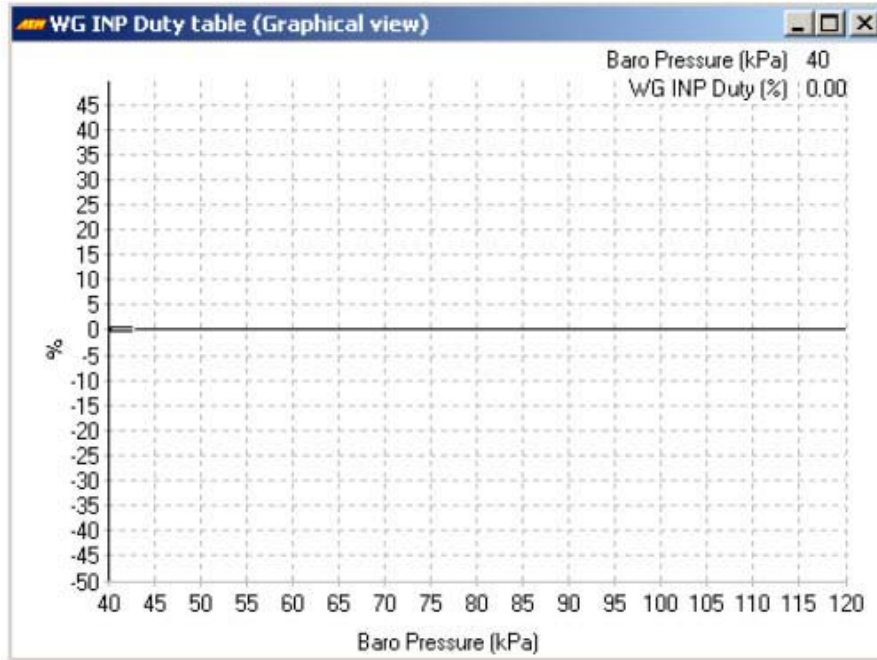


WG INP Duty table

Units: % Duty Cycle vs. Barometric Pressure

Description: Fluctuating barometric pressure boost stabilizer. This table is used to compensate for target boost against barometric pressure. Typically only used when at high altitude conditions, and the turbocharger has to over spin to create the desired boost from lack of air density. Set this table when compressor surge is taking place at high altitude.

Typical Use: This table is used to keep an appropriate duty cycle to maintain the boost target at different altitudes.



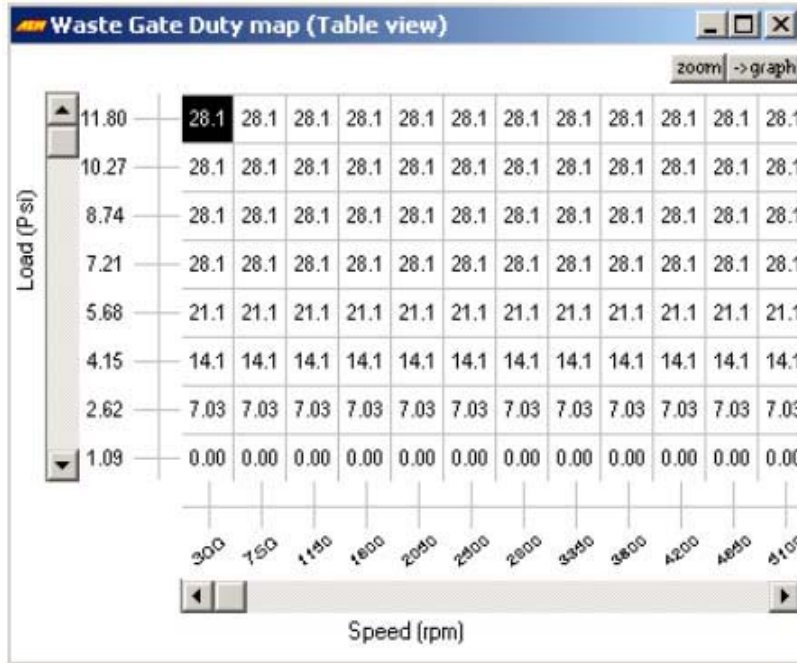
3-D Tables for Boost Control

Waste Gate Duty map

Units: Load vs. RPM vs. % Duty Cycle

Description: Base waste gate duty cycle at specific loads and engine speeds. This Map is used to set the base duty cycle to the boost control solenoid. Set this by turning all of the closed loop feedback boost control off, and adjusting the duty map until the desired boost target is as closely achieved as possible. The closer this base duty map is, the better the closed loop boost control feedback will work.

Typical Use: This map determines the base duty cycle percentage used if or if not using closed loop boost control feedback. This is the first map to tune when enabling boost control.

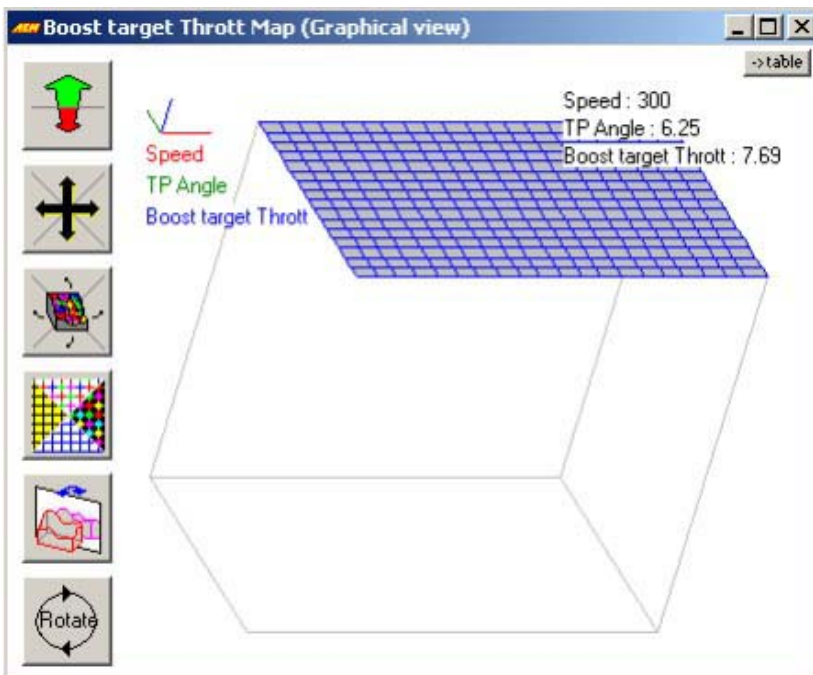


Boost target Thrott Map

Units: TPS vs. RPM vs. Boost Target

Description: Throttle dependant boost target control. This is the map that determines the closed loop boost control against throttle position. This is used as the boost target when the Boost FB VSS is set to Off. Note: When the Boost switch input is used, the boost switch target over rides this map when the switch is active.

Typical Use: This map is used to alter the target boost pressure at specific TP angles. To use this Boost target Thrott Map for boost feedback, the option Boost FB VSS must be Off.



Parameters for Boost Control (can be viewed or logged)

Boost Error

Units: Load

Description: Load needed to achieve the boost target value.

Boost Target

Units: Load

Description: Load value that the waste gate is attempting to achieve.

Waste gate mod

Units: Duty Cycle %

Description: Modification from the Waste Gate Duty Map used for the trim control function.

WG Duty (err)

Units: Duty Cycle %

Description: Duty cycle difference from the Waste Gate Duty Map.

WG Duty (map)

Units: Duty Cycle %

Description: Direct duty cycle output from the Waste Gate Duty Map.

WG Duty (mod)

Units: Duty Cycle %

Description: Waste gate duty cycle modification for trim control.

WG Duty Out

Units: Duty Cycle %

Description: Final duty cycle output to the boost solenoid.

WG Duty P+I err

Units: Duty Cycle %

Description: Duty cycle difference from the P+I control to the Waste Gate Duty Map.

Troubleshooting Boost Control

Waste gate stays closed and allows too much boost pressure.

- Depending on how the boost solenoid is installed, the Waste Gate Duty Map needs more or less duty percentage. See the above diagrams to determine the appropriate direction.

Waste gate opens and does not allow enough boost pressure.

- Depending on how the boost solenoid is installed, the Waste Gate Duty Map needs more or less duty percentage. See the above diagrams to determine the appropriate direction.

Boost is over damped and takes too long to reach the boost target

- Depending on how the boost solenoid is installed, the Waste Gate Duty Map needs more or less duty percentage. See the above diagrams to determine the appropriate direction.

- If using WG Error control, the Boost Error Dutys line is too flat. In other words, draw this line more vertical to provide more boost correction.
- If using P+I, the proportional is too small.

Boost overshoots and has too much correction.

- Depending on how the boost solenoid is installed, the Waste Gate Duty Map needs more or less duty percentage. See the above diagrams to determine the appropriate direction.
- If using WG Error control, the Boost Error Dutys line is too vertical. In other words, flatten this line to provide less boost correction.
- If using P+I, the proportional is too large.

There is an irritating noise coming from the pulse width boost solenoid.

- Change the frequency of the solenoid using WG PW and WG PW*256.

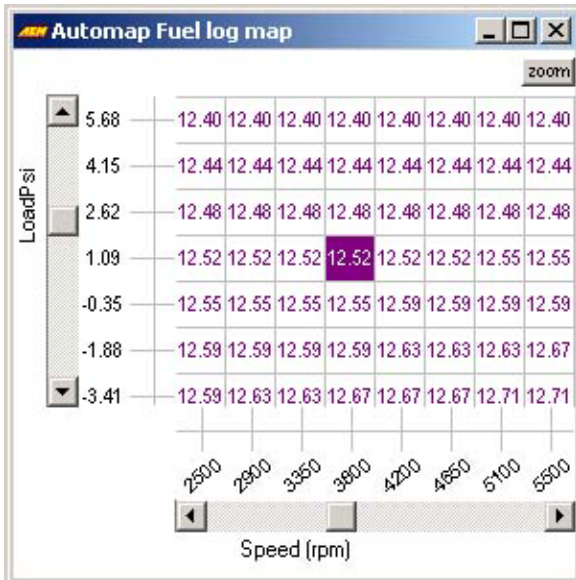
Auto Mapping

Auto mapping is a tool that allows maps to be changed automatically. This is not to be confused with closed loop O2 feedback, which only makes fuel output corrections. Auto mapping makes changes to the actual map by extracting data from AFR#1, thus affecting air fuel ratios and simplifying the tuning process. This feature is active only above 5% throttle in order to keep the deceleration fuel function working and to maintain consistent idling. In the AEMPro software, the Auto Map function utilizes three adjustable windows:

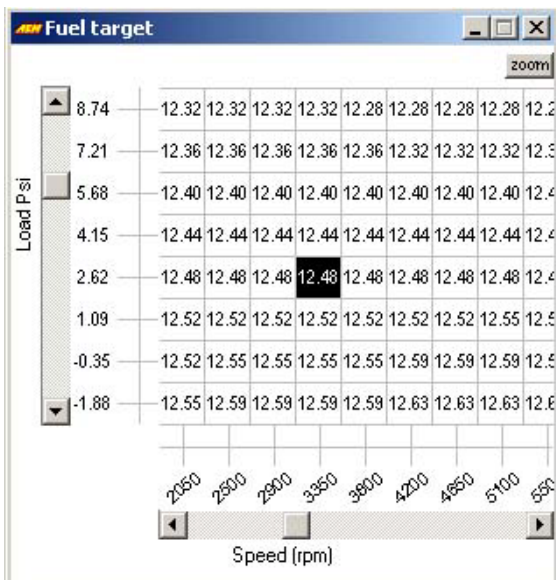
Automap Fuel log map
Fuel target
Auto Mapping

The Automap Fuel log map allows a parameter to be monitored and logged for different engine states, specifically for those, which correspond to sites of a map. Each site of the map has a value and a weighting. The weighting indicates the collected value for a specific cell. The value gives the average of this collected data.

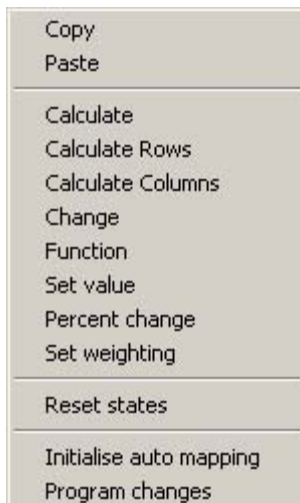
The weight of any value is always between 0 and 1. This is dependant on how close it references a particular site. In other words, when engine load and engine speed approaches a particular site, the value of the air fuel ratio is logged into the corresponding site of the Automap Fuel log map. As more values of air fuel ratio are collected for that site, the values are averaged out. Eventually a map can be built showing how the air fuel ratio varies across the entire load and speed map (shown below).



The Fuel target window enables target values to be entered via the end user. It is important to have an educated judgment and to check these values before starting the auto mapping function. It is also a good idea to monitor the shape that the Fuel Map is taking to ensure proper O2 feedback. These air fuel ratio values correlate with the respective sites of the Automap Fuel log map as used when auto mapping.



Right clicking in the Automap Fuel log map will create an auto mapping dialog box (shown below).

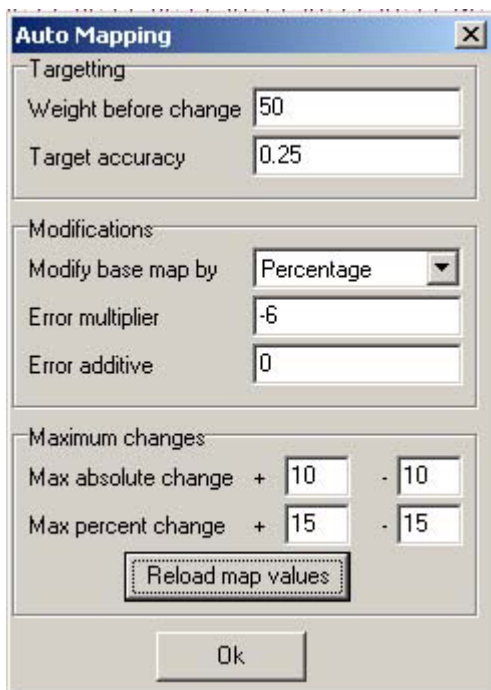


Start auto mapping begins the process of auto mapping based upon the last values set in the Fuel target and Auto Mapping windows. The menu option will then change to Stop auto mapping which, when clicked upon, stops the auto-mapping feature.

Reset states will reset the reference points for the limit constraints, thus allowing more movement in the map being modified if a cell has reached a limit.

When auto mapping is not employed, Program changes allows for the end user to extract the logged data and manually select appropriate cells for automatic correction.

Initialize auto-mapping opens an option menu (shown below).



The Weight before change value determines the cumulative weight of values collected for a site before any modification is made to the base map.

The target accuracy determines the minimum absolute difference between the average logged value and the target value for which a change should be made to the base map. In other words, from this value there will be no correction made within (+/-) of the targeted air fuel ratio value.

If both of these conditions are met, auto mapping will be enabled. However, the amount of change is constrained by Maximum changes. When these thresholds are met, there will be a limitation on the changes to the base map unless the Reload map values button is used.

Reload map values operates the same as the Reset states function, i.e.: resets the reference points for the limit constraints, thus allowing more movement in the map being modified if a cell has reached a limit.

When Modifications are made to the base map, the difference between the log map and the target map is calculated and the Error multiplier and Error additive are applied to the result:

$$\text{Change} = (\text{Target Map value} - \text{Log Map value}) * \text{Error multiplier} + \text{Error additive}$$

Since the default equation has the actual log value subtracted from the target value, the Error multiplier and Error additive will always be negative numbers in order to apply the correct direction for mapping control.

Assuming air fuel ratios will never leave the range of 9:1 to 17:1, the Error multiplier should never be less than (-11) or greater than (-6). However, the conservative approach is to keep this value close to 0 for more gradual changes. A large (negative) number is good for rich conditions and a small (negative) number is good for lean mixtures. After the map has been corrected for optimization and is drivable, a typical Error multiplier value is (-7).

This resultant value is then applied to the base map value as a Percentage increment or Addition depending on the choice selected.

Below is a visual example comparing the difference between an Error Multiplier of -8 and -7. Also, there is a link at the bottom to the actual Microsoft Excel spreadsheet. Feel free to try different Error Multipliers and Air Fuel Ratios.

Error Multiplier **-8**

Lean Mixture by 1 AFR Point

Target	Actual	Error	Change	New Value	New Error
11	12	-1	0.08	11.04	-0.04
12	13	-1	0.08	11.96	0.04
13	14	-1	0.08	12.88	0.12
14	15	-1	0.08	13.8	0.2
15	16	-1	0.08	14.72	0.28

Rich Mixture by 1 AFR Point

Target	Actual	Error	Change	New Value	New Error
16	15	1	-0.08	16.2	-0.2
15	14	1	-0.08	15.12	-0.12
14	13	1	-0.08	14.04	-0.04
13	12	1	-0.08	12.96	0.04
12	11	1	-0.08	11.88	0.12

Error Multiplier **-7**

Lean Mixture by 1 AFR Point

Target	Actual	Error	Change	New Value	New Error
11	12	-1	0.07	11.16	-0.16
12	13	-1	0.07	12.09	-0.09
13	14	-1	0.07	13.02	-0.02
14	15	-1	0.07	13.95	0.05
15	16	-1	0.07	14.88	0.12

Rich Mixture by 1 AFR Point

Target	Actual	Error	Change	New Value	New Error
16	15	1	-0.07	16.05	-0.05
15	14	1	-0.07	14.98	0.02
14	13	1	-0.07	13.91	0.09
13	12	1	-0.07	12.84	0.16
12	11	1	-0.07	11.77	0.23

Knock Control Configuration

The AEM EMS has 2 inputs for knock sensors. These can be passive, where data is displayed and/or recorded or the feedback knock control can be enabled, letting the EMS take action to counter the knock. To do this, the EMS can either retard the timing or richen the fuel mixture, or both. To setup the knock control, you have to:

- Identify which cylinders correspond to each knock input.
- Identify the knock signal threshold above, which is “real” knock.
- Define the rate of additional fuel to be added for knock.
- Set a maximum amount of fuel to be added for knock.
- Define the rate that it will be removed after the knock is gone.
- Define the rate of spark retard to be added for knock.
- Set a maximum amount of ignition retard for knock.
- Define the rate of spark advance back to normal values after the knock is gone.
- Activate the knock system.

This type of description is best described in an example. For the purpose of this, an inline 4-cylinder engine will be used with 1 knock sensor, connected to Knock1. It will also be assumed that this engine running “wasted spark” and is using Coil 1 for Cylinders 1 & 4 and Coil 2 for Cylinders 2 & 3.

Open the Options | Coil dialog box. This allows you to activate the coils and assign which knock sensor applies to that coil. For our purpose, we will activate the Knock1 checkbox for both Coil 1 and 2. This says that all knock control actions triggered by the signal coming in on Knock Sensor #1 should apply to these coils.

Open the Options | Injector dialog box. This allows you to activate the Injectors and assign which knock sensor applies to that Injector. For our purpose, we will activate the Knock1 checkbox for injectors 1,2,3 & 4. This says that all knock control actions triggered by the signal coming in on Knock Sensor #1 should apply to these injectors.

Alternately, you can go to the Options | Full List and just type in the values.

Code

```
Coil1Knock1 = “On”
Coil2Knock1 = “On”
Fuel1Knock1 = “On”
Fuel2Knock1 = “On”
Fuel3Knock1 = “On”
Fuel4Knock1 = “On”
```

Additionally, make sure that the Knock2 channels are off.

So now the EMS knows that if the Knock 1 input detects “knock” then whatever action it takes should apply to Coil 1 and 2 as well as Injectors 1-4. Now we need to define what the EMS considers “knock”

These is a “Knock Noise Table” under the Ignition menu, which sets an RPM dependant threshold to filter out background noise. Setting up this table is key to the success of this function. Whenever the knock sensor voltage output exceeds this table’s value, it is considered to be “real knock” and the difference between the actual knock signal and this threshold value determines the severity of the knock.

The best way to set this table is with the aid of the data logger. By logging the Knock Raw#1 channel when the engine is under load and not knocking gives you a picture of the background noise on the knock sensor channel. This is mechanical noise in the engine that is near the same frequency as knock but is not real knock.

By using this data, you can now draw the knock noise table versus RPM. The table should be about 10-25% above the typical knock sensor value that you recorded and will start off very low and increase with RPM.

After setting up the knock sensors and the “Knock Noise Table” the EMS knows what knock sensor applies to what cylinder and what Knock signal constitutes real knock. So now we need to define what

exactly the EMS should do when it sees knock.

Setting up the Fuel enrichment function should be the first response to knock as it does not reduce power as dramatically as retarding the ignition. To add fuel, you have to define how much extra fuel; expressed in % to add for each volt the knock sensor input exceeds the "Knock Noise Table". This is done with the "Knock Rich" term. The amount to step the fuel back to normal, expressed in % is the "Knock dec" term and the rate at which to increment the knock modifications back to normal is "Knock rate" and is expressed in engine revolutions. To keep the engine from becoming overly rich, there is a "Knock Fuel Max" term, which sets the maximum amount of fuel that the knock routine can add, no matter how severe the knock is.

So for our example, if I wanted to add 3% of fuel for each volt of knock, but not to exceed 10% of fuel in total and return the fuel back to normal 1% every 50 engine revolutions I would set the following:

Code

Knock control = "On"
Knock rate = 50 rev
Knock Rich = 3.0 %
Knock dec = 1%
Knock Fuel Max = 10.0 %

Setting up the spark retard function retards the ignition timing in response to knock. To retard the timing, you have to define how much timing; expressed in degrees to remove for each volt the knock sensor input exceeds the "Knock Noise Table". This is done with the "Knock Rtd" term. The amount to step the timing back to normal, expressed in degrees is the "Knock inc" term and the rate at which to increment the knock modifications back to normal is again, the "Knock rate". To set the limit for timing retard there is the "Knock Rtd Max" term that sets the maximum amount of spark retard that the knock routine implement, no matter how severe the knock is.

Example: If I wanted to also retard the timing 5 degrees for each volt of knock, but not to exceed 12 degrees of total retard and then advance the timing back to base by 0.75 degrees every 50 engine revolutions I would set the following:

Code

Knock Rtd = 5.0 degrees
Knock inc = 0.75 degrees
Knock Rtd Max = 12.0 degrees

Once this is all done, you can view or log these parameters to monitor and fine tune your knock control setup:

Knock Raw#1(2)

This is the raw input voltage that is incoming on the Knock 1 channel.

Knock#1(2)

Amount of current knock (Knock Raw#1 – Knock Noise Table) Knock control must be on for this to be active.

Knock Tooth#1(2)

Current crank tooth value when the latest knock event was triggered.

Knock Fuel#1(2)

Amount of current fuel enrichment due to knock feedback control.

Knock Rtd#1(2)

Amount of current timing retard due to knock feedback control.

Secondary Injector Configuration

The AEM EMS has 10 individually controlled injector drivers. By default, they are assumed to be driving primary fuel injectors. Alternately, they can be defined as secondary, or “staged” injectors. These can be activated on an “as needed” basis or by a user defined ratio between the two based on engine RPM and load.

This type of description is best described in an example. For the purpose of this, a 4 cylinder engine with a firing order of 1-3-4-2 will be used. It will also be assumed that this engine is using injector 1 for cyl 1, injector 2 for cyl 2 etc... and has a 12 tooth crankshaft trigger wheel. It has 240cc injectors and we want to add 2 staged 720cc injectors using injector outputs 5 & 6 however any open injector driver may be used, in any order. To define an injector as staged, the injector must first be turned “On” and the “FuelX Secondary” (where X is the injector number you are setting up) to “On”. Additionally, you have to tell the EMS that the existing injectors (1-4) are going to act as the new primary injectors. So we will set the two options for each injector:

Code:

```
Injector5 = “Active”
Injector6 = “Active”
Fuel5 Secondary = “Active”
Fuel6 Secondary = “Active”
Fuel1 Primary = “Active”
Fuel2 Primary = “Active”
Fuel3 Primary = “Active”
Fuel4 Primary = “Active”
```

Additionally, you now need to set where in the engine cycle you want the new staged injectors to begin their injection pulse. This is set in the same manner as primary injectors and is done with the option called: “Inject Tooth #X”. This value is in crankshaft pickup teeth (a.k.a. fuel teeth) after TDC #1 compression. This value is proportional to degrees of crankshaft rotation. It’s actually quite helpful to understand that the EMS actually counts the number of crankshaft teeth passing until it gets to this number and then starts injection. So for a 12 tooth crank trigger wheel on a 4 stroke engine, there are 24 teeth per cycle. If the “Inject Tooth #6” was set to “17.6”, that would tell the EMS to let 17.6 teeth pass ($720/24 * 17.6 = 528$ crankshaft degrees into the cycle and yes, you can do partial teeth) and then activate Injector #6. For this example, we will simply have them begin injecting at TDC for their respective cylinders (just like the associated primary injectors).

Code:

```
Inject Tooth #5 = “0.0”
Inject Tooth #6 = “12.0”
```

It is important to note that this is NOT the final injection location, it is just a reference point. All injectors, primary and secondary are under control of the “Inj Advance Map” a Load vs. RPM table that is used to set the actual “injection phase” of the injectors.

So now the injectors are on, defined as secondary injectors and their start location is defined in the engine cycle. Now we need to define the flow rate differences between the primary and secondary injectors. This is necessary to accurately distribute the required fuel between the two different delivery systems. It represents the % of primary injection time needed to flow an equivalent amount of fuel from

the secondary injectors and is entered in a option called "Secondary".

$$\text{Secondary} = (\# \text{ Main Inj}/\text{Main Flow Rate}) / (\# \text{ Sec Inj}/\text{Sec Flow Rate}) * 100) - 100$$

So for our example 4 cylinder with 240cc primaries, we plan to add two 720cc secondaries (units do not matter). The equation is as follows:

$$\text{Secondary} = (4*240)/(2*720)*100 - 100 = -33.33$$

Code:

```
Secondary = "-33.33%"
```

With this latest change, the EMS knows that 33.33% less injection time is required for the secondary injectors to flow the same amount of fuel as the primary injectors. Remember, this is not simply the flow ratio between the 2 different injectors; it factors in the number of injectors as well. This number can range from -100 to +100.

The last thing required to define the injectors is to tell the computer how fast the injector responds to the fuel pulse signal. Under the "Fuel | Fuel Corrections" menu is the Battery Comp Table. This is how long the primary injectors take to start flowing fuel after they have been turned on and is a function of battery voltage. There are 2 different tables, one for primary and the other for the secondary injectors. Since the primary and secondary injectors are usually different types, these tables should be different. The table for the secondary injectors is located under the "Fuel | Fuel Corrections" menu and is called "Battery Comp #2 Table". If the injector response data did not come with your injectors, simply copy the one you are using for your primary injectors.

The 2 extra injectors are now completely defined in software. The only thing remaining is to specify when and how much should be directed to the new staged injection system. There are 2 different methods for transferring fuel from the main injectors to the staged injectors.

The most basic is based on the duty cycle of the mains where you set the maximum injector duty you want to run through the mains and the minimum on time for the secondary injectors.

Code:

```
Injector Duty MX = 60%  
Injector min = 500 microseconds
```

This sets the injectors to run only on the mains until the base injector duty cycle exceeds 60%. Once that has occurred, the fuel in excess of Injector Duty MX is routed to the secondary injectors. The injector min keeps the system from quickly switching back and forth between the two if the duty were to stay right at 60%. The secondary injectors will stay on until the base injector duty cycle decreases below 60%.

The second method for mapping fuel to the staged injectors uses the Fuel Diff Map and the Injector Duty MX controls in unison. The Fuel Diff Map allows you to specify what percentage of fuel should be delivered via the secondary injectors. This can be set based on load and RPM and gives the best control. To set this up you need to put the appropriate values into the Fuel Diff Map and set the Fuel Diff option to on.

Additionally, there is a switch input available, called "Diff SW" where the staged injection can be disabled from the cockpit. If this is used, it needs to be assigned to the channel where the switch input is located. If only the software operating criteria is used, set the "Diff SW in pin" to "Switch is Always On". This says

the switch is always on so only the software criteria is used. It is important to remember that the Injector Duty MX limit will still be used so set that value to a reasonable number.

So for our example using the Fuel Diff Map to define the split percentages, but to also never allow more than 90% duty cycle on the main injectors and not using a cockpit as an enabling input, we will set these parameters:

Code:

```
Fuel Diff = "On"  
Diff SW in pin = Switch is Always On" (disables and ignores the switch input)  
Fuel Diff Map = Percentage of fuel you want on the secondary injectors  
Injector Duty MX = 90%  
Injector min = 500
```

With this complete, the staged injection control should be functioning properly. You can view and/or log the actual base injection times with the "Fuel Pulse Primary" and "Fuel Pulse Secondary" parameters.

You still should map the fuel in the same way as with standard injection. Just make sure that you have the quantity of fuel available to support your engine.

Also note, this description is for V89 and later software, if you are trying to set up staged injection on earlier software, please call tech support.

Nitrous Oxide Configuration

There are several ways to control Nitrous with the AEM EMS. With the AEM EMS the user has complete control over all of the nitrous functions, when it activates and de-activates the solenoids, and how much fuel and timing trims are added.

The basic Options that apply to the Nitrous control are as follows:

N2O Control

This switch enables the Nitrous control options and Tables. Set this to ON to allow the Nitrous control to become active.

N2O in pin

This sets the input for the Request for Nitrous to become active under the set parameters.

N2O Out pin

This sets the output to be used to activate the relay for the Nitrous control solenoids.

N2O Max Load OFF

Above this Load (pressure) the EMS will de-activate the nitrous control. This can be used to Spool a turbo charger, then turn off once the desired boost has been reached, or as a safety measure to prevent the nitrous from being active in an over boost situation. When the engine reaches this load point, the EMS will cut the active signal to the nitrous relay, and disable any Trims that have been set. Set this to the maximum allowable pressure to be active.

N2O Load ON

Units: %

Above this Load (pressure) the nitrous solenoid will be allowed to become active providing the remainder of the Nitrous options criteria have been met.

N2O Load Min

Units: %

This is the Minimum Load (pressure) value needed to reactivate the nitrous control after it has been de-activated by the parameter *N2O Max Load OFF*.

Engine Load must drop below this value to reactivate.

N2O Spd OFF

Units: RPM

Above this RPM the EMS will de-activate the nitrous control and any trims. This is used as a safety measure to prevent hitting the rev limiter while the nitrous is active. When the engine reaches this RPM, the EMS will cut the active signal to the nitrous relay, and disable any Trims that have been set. Set this number 200-rpm below the rev limiter.

N2O Spd ON

Units: RPM

Above this RPM the nitrous relay and any trims will activate as long as the remainder of the nitrous options criteria have been met. Set this number to the minimum allowable RPM for the Nitrous to be active.

N2O TPS OFF

Below this number the nitrous will not be able to activate. Typically this number is set to 85

N2O TPS ON

Above this number the nitrous will be able to activate. Set this number just above the N2O TPS OFF condition.

NOTE: All of the Nitrous Options must be met for the EMS to activate the selected output. If any one of the Options falls out of their on conditions, the control will be disabled.

Nitrous Tables used to control fuel and timing trims:

N2O Fuel Map

This map allows a percentage of additional fuel to be added or subtracted from the base map when the nitrous options become active. This map allows adjustment over engine speed and engine load.

N2O Ignition Map

This map allows ignition timing to be advanced or retarded against the base ignition map when the nitrous control is active. This map is adjustable over engine speed and engine load.

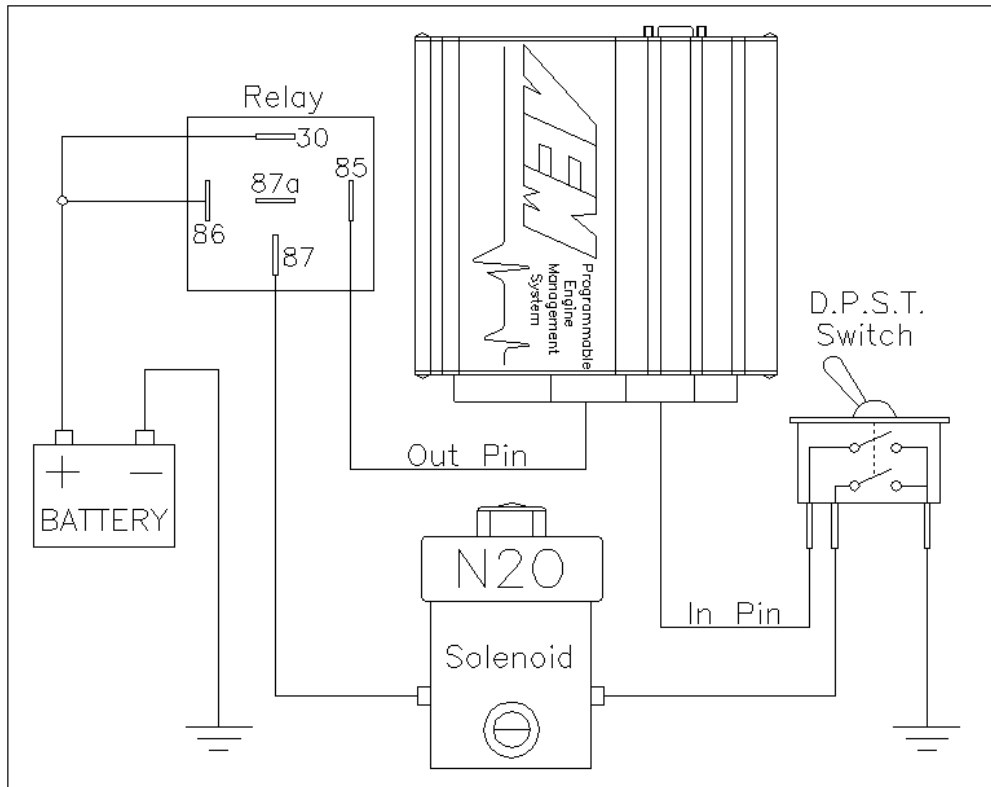
Example of a typical nitrous set up:

- N2O Control - On
- N2O in pin - 2 (For Speed 2 input)
- N2O out pin - 1 (For LS1 to trigger nitrous solenoid relay)
- N2O Load Off - 300 Kpa (to prevent over boost) Set this above the desired operating boost pressure.
- N2O Load On - 120 Kpa (will engage at and above this condition)
- N2O Speed Off - 9000 RPM (to prevent hitting a rev limiter on the nitrous)
- N2O Speed On - 3000 RPM (to prevent low engine speed activation)
- N2O TPS Off - 90% (will not activate below this position)

· N2O TPS On – 91% (activates above this condition)

N2O fuel table – Since this is a 3d table, there are several variations of what may be needed. If the Nitrous system being used is a wet system, very little trim may be entered into this table. If the Nitrous system is a dry system, values dependant upon the size of the nitrous will dictate the percentage of increase into this table.

N2O Ignition table – Typically negative values are entered in this table dependant upon the amount of Nitrous being used. Typical numbers might be –5 degrees advance.

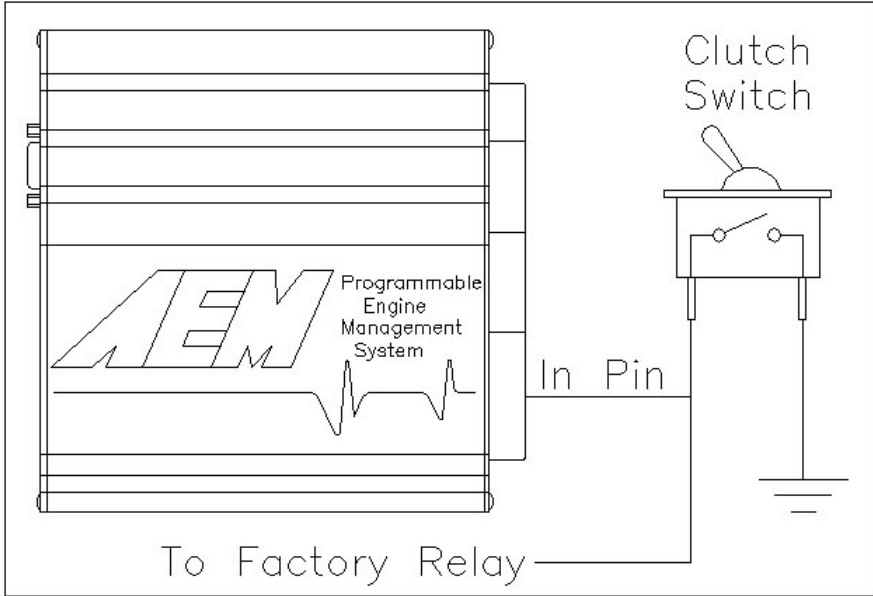


2 Step Rev Limiter

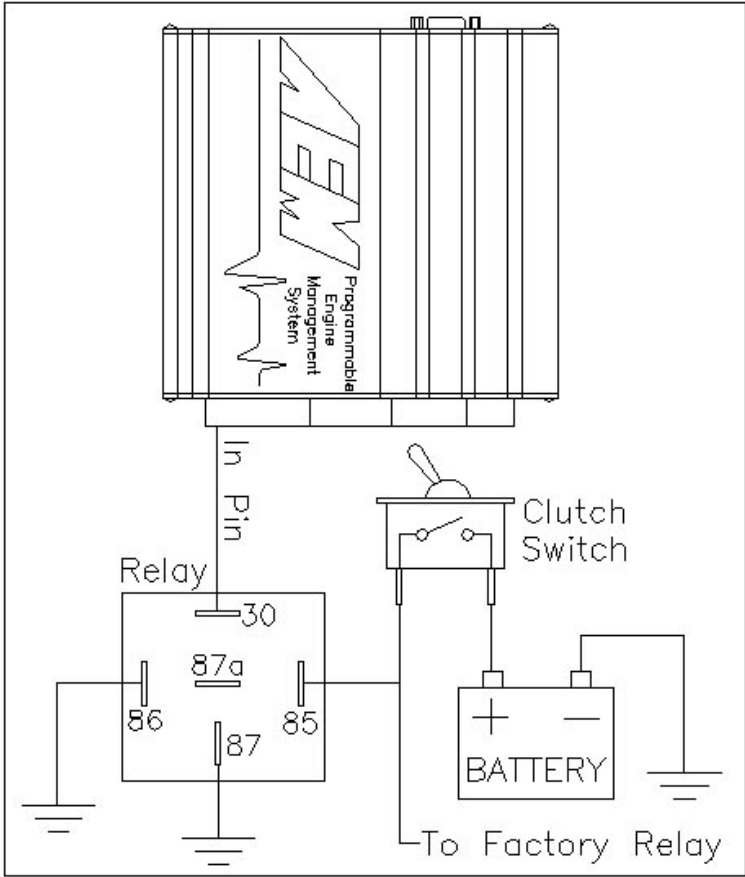
Secondary rev limiters (2 step) are most commonly used in drag racing for consistent vehicle launches. However, secondary rev limiters can also be used for full throttle shifting, anti-lag, valet parking, etc.

There are many different ways to install and program a 2 Step Rev Limiter with the AEM EMS. Although any switch can be used, utilizing the factory clutch switch is most common. However, if you do not care to have the clutch activate the 2 step rev limiter and would rather not wire anything go here

Most vehicles use a pull to ground switch. This simple installation involves splicing a wire from the clutch switch location to an available switch on the EMS, as shown below. The switch information for your specific application can be found on the pin out sheet in the Electrical section on the EMS forum.



Other vehicles, including the Toyota Supra Mark IV, use a 12-volt clutch switch. Since the EMS's switches pull to ground, this situation will call for a relay to pull the switch to ground, as shown below.



The secondary rev limiter options in the AEMPro software are located under the Setup pull down menu. This is where user-dependant rev limiter adjustments can be made.

Fuel Cut 2nd

Units: RPM

Description: User defined RPM to enter the secondary fuel cut rev limiter.

Typical Use: Naturally aspirated engines will use this for soft launches whereas turbocharged vehicles may not cut fuel to encourage anti-lag spool up.

Fuel Cut Rate

Units: %

Description: Amount of fuel to cut when the 2-step rev limiter is active. The sum of the Fuel Cut rate and the Fuel Cut + cannot exceed 100%.

Typical Use: Used in conjunction with Fuel Cut + for soft rev limiting.

Fuel Cut +

Units: %

Description: Additional fuel cut rate added after the specified RPM has been exceeded. The sum of the Fuel Cut + and the Fuel Cut Rate cannot exceed 100%.

Typical Use: Used in conjunction with Fuel Cut Rate for soft rev limiting.

Ignition Cut 2nd

Units: RPM

Description: User defined RPM to enter the secondary ignition cut rev limiter.

Typical Use: Naturally aspirated engines will use this for soft launches whereas turbocharged vehicles may use this to encourage anti-lag spool up.

Ign Cut Rate

Units: %

Description: Amount of ignition to cut when the 2-step rev limiter is active. The sum of the Ign Cut Rate and the Ign Cut + cannot exceed 100%.

Typical Use: Used in conjunction with Ign Cut + for soft rev limiting or anti-lag.

Ign Cut +

Units: %

Description: Additional ignition cut rate added after the specified RPM has been exceeded. The sum of the Ign Cut + and the Ign Cut Rate cannot exceed 100%.

Typical Use: Used in conjunction with Ign Cut Rate for soft rev limiting or anti-lag.

RevLimit2 VSS

Units: MPH

Description: Vehicle speed threshold to deactivate the secondary 2 step rev limiter.

Typical Use: This is applied when full throttle shifting is not used. This feature also helps allow automatic transmission vehicles to use the 2-step rev limiter.

Rev Limit In Pin

Units: Channel

Description: Channel input for the secondary rev limiter.

Typical Use: Used to assign the specific pin used to activate the secondary rev limiter.

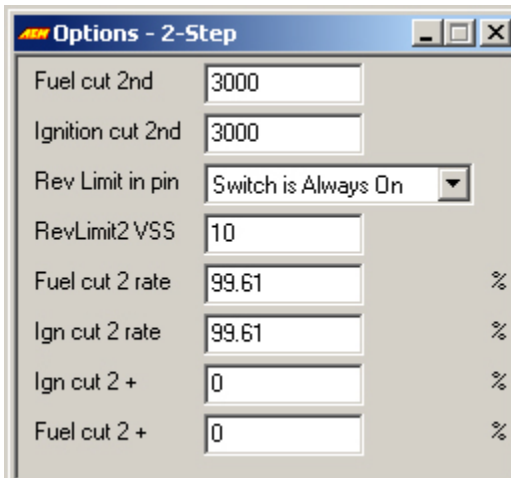
VSS 2-Step Rev Limiter Installation

This installation does not require a clutch switch input, i.e.: NO WIRING! This strategy will work for all EMS Part Numbers as long as the vehicle speed sensor (VSS) is still being used.

In the AEMPro software go to:

Setup | Rev Limiter | Options - 2-Step

Set up this option's window like the example below. Enter the appropriate Ignition cut 2nd and Fuel cut 2nd RPM values to activate the limiter. The Ign cut 2 + and Fuel cut 2 + options will need to be tuned to achieve the desired type of cut (hard or soft). This example deactivates the 2-step rev limiter after 10 mph. Note: The RevLimit2 VSS must be met before the Fuel/Ignition cut 2nd RPM.



Fuel Pump

To achieve proper fuel delivery, the correct fuel pump for your application is crucial. In most cases, where the engine has been modified only with “bolt on” performance items, there is rarely a need for a larger fuel pump. Vehicle manufacturers typically design a “safety factor” into the fuel pump to accommodate the deterioration of the fuel system over time. This safety factor is intended to compensate for a fuel filter that is nearing the end of its life, or for deposits in the injector orifice. Our research has revealed that generally there is about a 15%-20% oversize in most factory fuel pumps.

If the engine is enhanced via forced induction or nitrous oxide, the stock fuel pump will, most likely, be inadequate. If the engine's power is increased, more than 15-20% fuel delivery must increase as a factor of the power gain.

The way to determine the proper-size fuel pump is based on the desired brake specific fuel consumption (BSFC) of the engine. This term refers to how much fuel in pounds per hour (pph) the engine consumes per horsepower and is a measure of the efficiency of the engine. It is a useful term in determining the total fuel requirement of the engine.

On vehicles equipped with forced induction or nitrous oxide, a higher BSFC is required as an added measure of safety to prevent detonation or high combustion chamber temperatures. Naturally Aspirated gasoline engines have a BSFC of 0.48 to 0.50. Forced Induction gasoline engines have a BSFC of 0.65 to 0.68. Methanol (alcohol) powered engines require twice the amount of fuel so the BSFC is doubled.

Calculating the total fuel requirement of an engine requires simple equations that are outlined in the following section. You must know how much power the engine is anticipated to make. The fuel requirement will be determined in pounds per hour of fuel flow. Since most pumps are rated in gallons/hour, the weight of the fuel/gallon being used must be determined. The vast majority of gasoline based fuels run at 7.25 lbs/gallon. With fuel pump sizing, always use a safety margin greater than 20%. The equations to determine the fuel requirement is as follows:

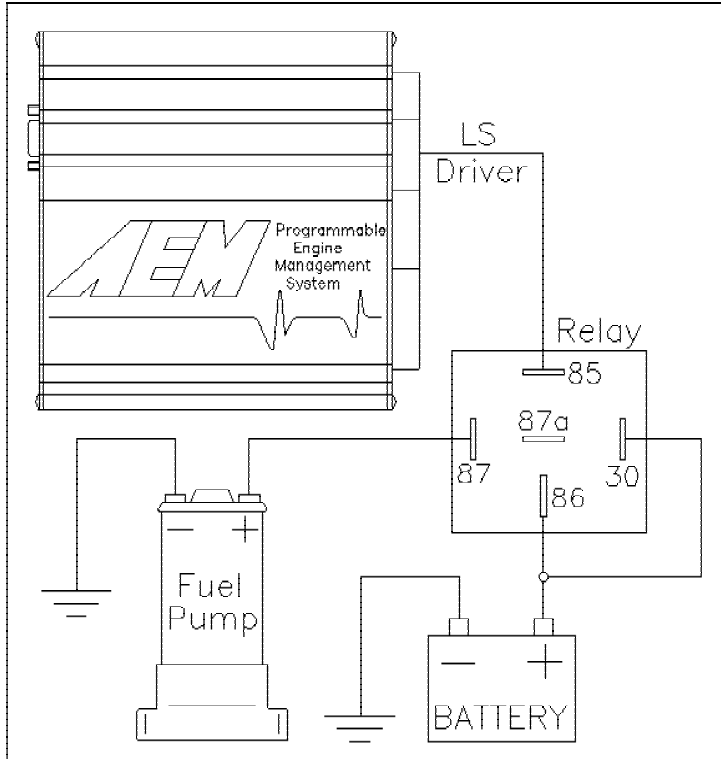
- ⇒ $(\text{Power} \times \text{BSFC}) \times (1 + \text{Safety Margin}) = \text{Pounds/Hour}$
- ⇒ $\text{Pounds/Hour} / 7.25 = \text{Gallons/Hour}$.

An example of this equation is:

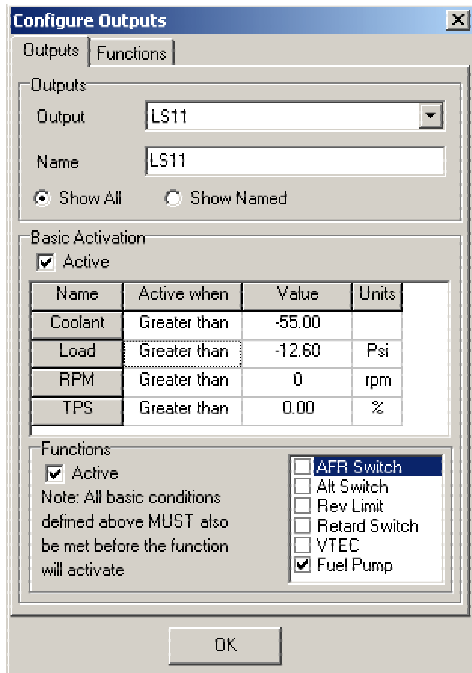
- ⇒ 500 hp gasoline engine using moderate boost with a 30% safety margin
- ⇒ $(500 \times 0.625) \times 1.30 = 406.25 \text{ lbs/hr}$
- ⇒ $406 \text{ lbs} / 7.25 = 56 \text{ gallons/hour}$
- ⇒ If the pump that is being considered is rated in liters per hour, use the conversion factor of 3.785 liters/gallon. The pump described above would be rated at $56 \text{ gallons} \times 3.785 \text{ liters} = 211.96 \text{ liters/hour}$.

The fuel pump should be located at a level that corresponds to the lowest part of the fuel tank. This does not mean that the pump should be in a vulnerable position such as hanging below the tank. The pump should also be positioned so that it is protected from road hazards, i.e.: speed bumps, curbs, road debris, etc. In the event of an accident, the vehicle structure around the fuel pump should not deform to a point where the pump and its electrical connections are compromised.

The wiring for the fuel pump must be rated for the amperage of the pump. As with all high current wiring, a fuse rated for the amperage of the pump should be used. The ground for the pump must be the same size as the power lead and be mounted to a location that is clean and clear of any undercoating or paint. We do not recommend running the fuel pump continuously (or off of the ignition switch) as this is very dangerous.



Fuel pumps can be run off any available low side (LS) or high side (HS) driver. As shown in the diagram above, we encourage an LS, or pull to ground, driver to be used for fuel pumps because of the high current they draw. Below is an example of how fuel pumps are setup in the Configure Outputs window of the AEMPro software.



Notice the Fuel Pump option in the diagram above. When the Fuel Pump function is activated and the key is in the "on" position, the circuit closes briefly to allow the fuel pump to prime. After a few seconds, the circuit deactivates and waits until an RPM signal is met during cranking. The circuit will then be active until the RPM signal

Wideband O2 Sensor and Controller

For accurate air fuel ratio readings, AEM recommends using a wideband O2 sensor and wideband O2 heater controller.

User Definable Options for O2

O2#1 Gain

Units: Gain Multiplier

Description: Sets the input gain for the #1 O2 Sensor.

Typical Use: Scales the raw voltage to read the same as the measured voltage input. The Toyota Supras typically uses 1.97, however, 1 is typical for most applications.

O2#2 Gain

Units: Gain Multiplier

Description: Sets the input gain for the #2 O2 Sensor.

Typical Use: Scales the raw voltage to read the same as the measured voltage input. The Toyota Supras typically uses 1.97, however, 1 is typical for most applications.

Parameters (can be viewed or logged)

Oxygen raw #1

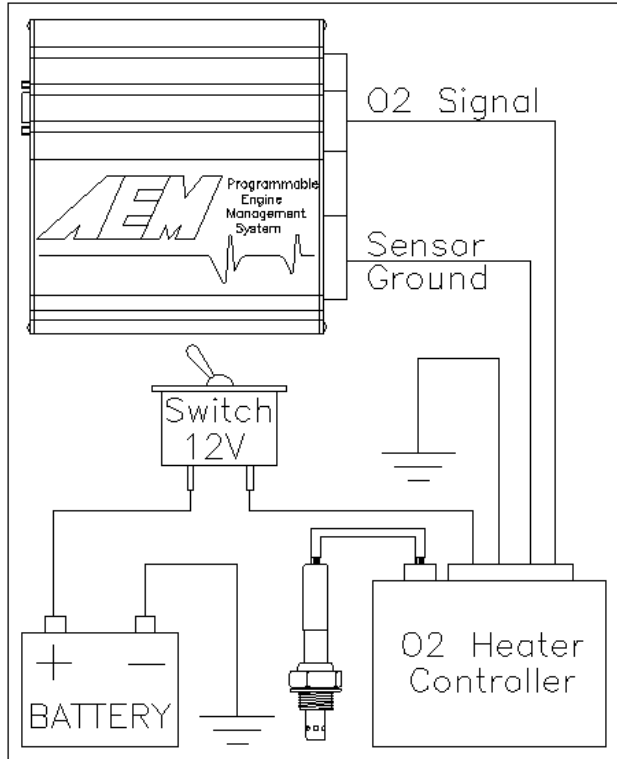
Units: Voltage

Description: Raw voltage signal from the #1 O2 sensor's heater controller.

Oxygen raw #2

Units: Voltage

Description: Raw voltage signal from the #2 O2 sensor's heater controller.



O2 Feedback

To control the engine's fuel delivery system, the EMS can be programmed to run open loop and/or closed loop O2 feedback. Closed loop uses feedback from the oxygen sensor to make temporary but immediate corrections to the injection to maintain a target AFR. The type of an O2 sensor will determine how O2 feedback can be controlled. Due to the nature of standard narrow band O2 sensors, 14.7:1 is the only air fuel ratio that can be accurately maintained in closed loop. However, wideband O2 sensors can be used in almost every feedback condition.

When the fuel system is open loop, the O2 sensor is ignored and the injector pulse width relies on the fuel map and fuel compensators to adjust injection duration. Open loop is necessary during engine starts when the O2 sensor has cooled below its operating temperature. It may also be necessary when coolant temperatures are low. In this state, the fuel vaporization is poor and the engine will require a richer mixture to properly operate. When under heavy load, the engine typically requires an air fuel ratio that is out of a narrow band O2 sensor's standard range and open loop will be necessary. When the accel fuel function is triggered during hard accelerations, open loop may be necessary to help stabilize the O2 feedback. When the decel function cuts fuel completely, O2 feedback will not be necessary.

Tuning O2 Feedback

The tuning procedure for O2 feedback can be quite tedious. One approach is to use a technique known as the Ziegler Nichols Tuning Method. The Ziegler Nichols closed loop method uses Proportional or P + I control and should produce tuning parameters which will obtain a quarter wave decay. The O2 feedback functions are located in the Fuel pull down menu in the AEMPro software.

- 1) Use the proportional control (O2 FB proportional table) by itself and set the integral time constant (O2 FB integral table) to zero.
- 2) Log the parameters AFR#1(or #2) and O2 F.B.#1 (or #2).

- 3) Increase the value of the proportional gain until the point of instability or a sustained oscillation is reached.
- 4) From here, the ultimate proportional gain (G_u) is found.
- 5) From the log, measure the period of oscillation from peak to peak, in seconds, to obtain the critical time constant or ultimate period (P_u).
- 6) Once the values for G_u and P_u are obtained, the P + I parameters can be calculated from the following equations.

Proportional feedback only (O2 FB integral table = 0)
 O2 FB proportional table = 0.5 (G_u)

Proportional and Integral feedback
 O2 FB proportional table = 0.45 (G_u)
 O2 FB integral table = (P_u)/1.2

Note that these values are not optimal values and additional fine tuning may be required to obtain the best O2 feedback performance.

User Definable Options for O2 Feedback

Parameter	Value	Units
O2 FB +Limit	19.92	%
O2 FB Coolant OK	50	
O2 FB Gain	1	
O2 FB -Limit	-19.92	%
O2 FB Load	15.18	psig
O2 FB Rate	65.59	mSec
O2 FB Speed	9000	rpm
O2FB control	<input checked="" type="checkbox"/>	
Accel Fuel Min	100	μ S
Accel O2FB inhibit	196	mS
Decel O2FB inhibit	196	mS

O2 FB +Limit

Units: Fuel %

Description: The maximum amount of fuel to add when O2 feedback is enabled.

Typical Use: If the proportional and integral controls have not been setup correctly, this value may need to be small to trim the fuel map.

O2 FB Coolant OK

Units: Coolant Temperature

Description: O2 feedback will operate when the coolant temperature has exceeded this value.

Typical Use: This value is typically set near operating temperature.

O2 FB Gain

Units: Gain Multiplier

Description: Overall O2 feedback gain

Typical Use: This value will always be one unless the proportional and integral gains are not sufficient in controlling the air fuel ratio.

O2 FB -Limit

Units: Fuel %

Description: The maximum amount of fuel to subtract when O2 feedback is enabled.

Typical Use: If the proportional and integral controls have not been setup correctly, this value may need to be small to trim the fuel map.

O2 FB Load

Units: Engine Load

Description: O2 feedback will operate when the engine load is below this value.

Typical Use: When using a narrow band O2 sensor, O2 feedback is typically not used at high engine loads because of the sensor's inaccuracy outside the stoichiometric range. However, O2 feedback can be used at high engine loads with a quality wideband O2 sensor.

O2 FB Rate

Units: mS

Description: O2 feedback base timer for both proportional and integral terms. This is how often the air fuel ratio is looked at to determine the correction.

Typical Use: A smaller number gives a faster response by effectively increasing the gain. This should be the same as the sampling rate of the O2 sensor being used. A typical value is 65.59 mS.

O2 FB Speed

Units: RPM

Description: O2 feedback will operate when the RPM is below this value but is not in cranking mode.

Typical Use: Limits O2 feedback control above the user-defined rpm.

O2 FB Control

Units: On/Off

Description: Enables closed loop O2 feedback and the AFR Target parameter.

Typical Use: After the fuel map has been tuned, O2 feedback can be enabled for automatic tuning adjustments.

Accel Fuel Min

Units: microseconds

Description: O2 feedback threshold for accel fuel. O2 feedback will operate when the current accel fuel amount is below this value.

Typical Use: Because accel fuel delivers an abundance of fuel in a very short amount of time, O2 feedback can ignore it to avoid possible air fuel ratio overshooting. However, using this function can still allow O2 feedback when there is a very small amount of acceleration fuel employed.

Accel O2FB inhibit

Units: mS

Description: O2 feedback delay after the accel fuel function has been disabled.

Typical Use: This function allows the mixture to be restored without using O2 feedback in order to prevent air fuel ratio overshooting. A typical value is 196 mS.

Decel O2FB inhibit

Units: mS

Description: O2 feedback delay after the decel fuel function has been disabled.

Typical Use: This function allows the mixture to be restored without using O2 feedback in order to prevent air fuel ratio overshooting. A typical value is 196 mS.

O2 FB Clear

Units: On/Off

Description: Sets O2 feedback to zero after both accel and decel fuel have been implemented.

Typical Use: After utilizing accel or decel fuel, the next condition will typically be different from before.

This function is used to allow the O2 feedback to clear its memory and start from zero again.

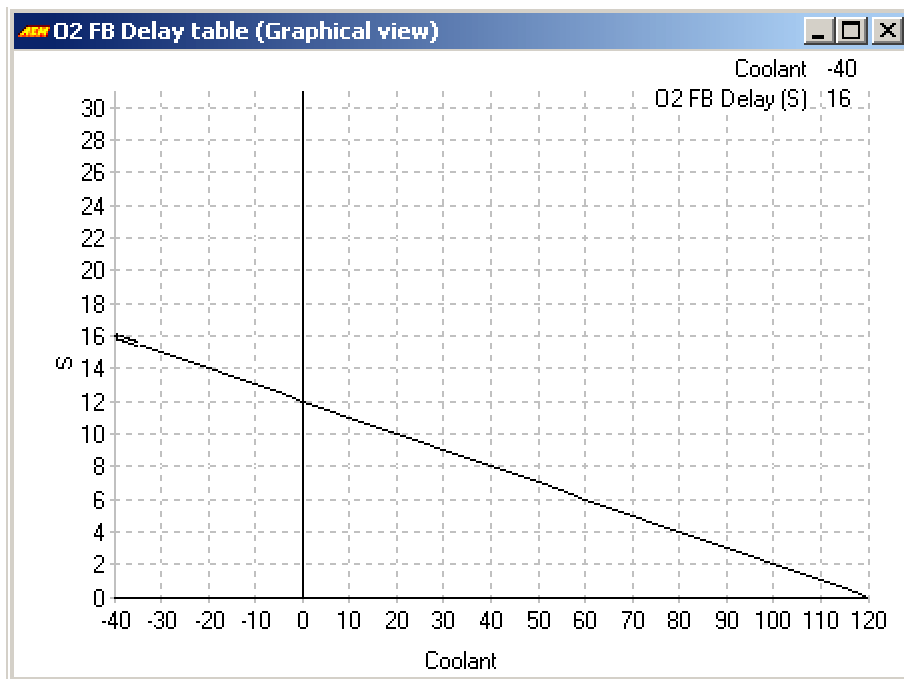
2-D Tables for O2 Feedback

O2 FB Delay Table

Units: After Start Time vs. Coolant Temperature

Description: Coolant dependant table for O2 feedback after start delay.

Typical Use: This table disables the O2 feedback for a set amount of time to allow a rich engine start and allow time for the O2 heater to warm up. This should never be faster than the time response of the O2 sensor's heater.

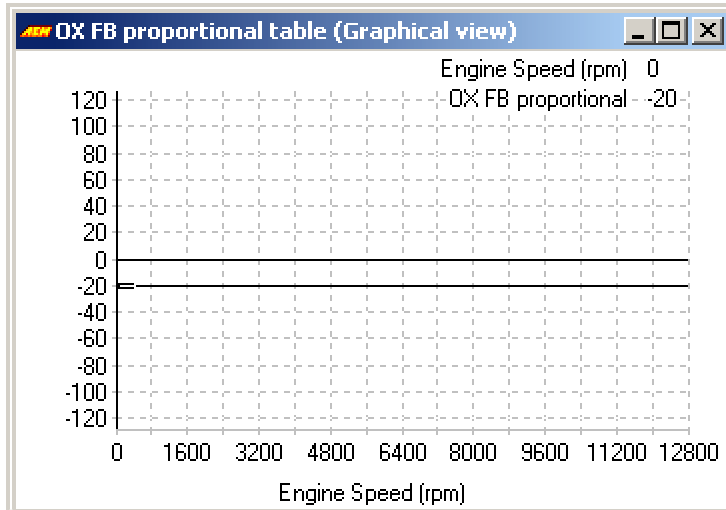


O2 FB proportional table

Units: Proportional Gain vs. RPM

Description: Proportional control is a pure gain adjustment acting on the error signal to provide the driving input. The advantage of a proportional-only control is its simplicity. If AFR offsets can be tolerated, the use of a proportional controller may be optimal. However, it will not eliminate the steady-state error that occurs after a set-point change or a sustained AFR disturbance. Note: When tuning the O2 feedback and overshoot occurs, lower this number. If undershooting the AFR target, raise this number.

Typical Use: Used to adjust the speed of the system and reach the AFR target quickly.



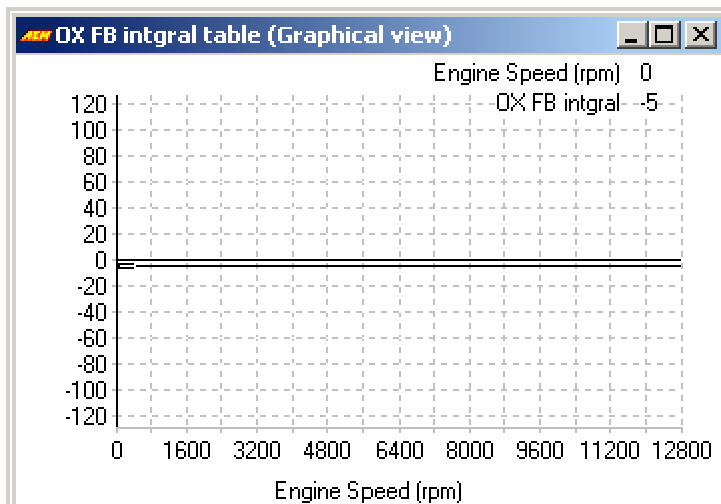
O2 FB integral table

Units: Integral Gain vs. RPM

Description: Integral control is implemented through the introduction of an integrator. This is used to fine tune the O2 feedback at the AFR target once the proportional has acted in getting close to the target.

Note: start tuning the O2 feedback with this option at zero, until the proportional has the feedback close to the target, then step this in slowly until the feedback holds the AFR target.

Typical Use: Integral control is used to provide the required accuracy for the control system.



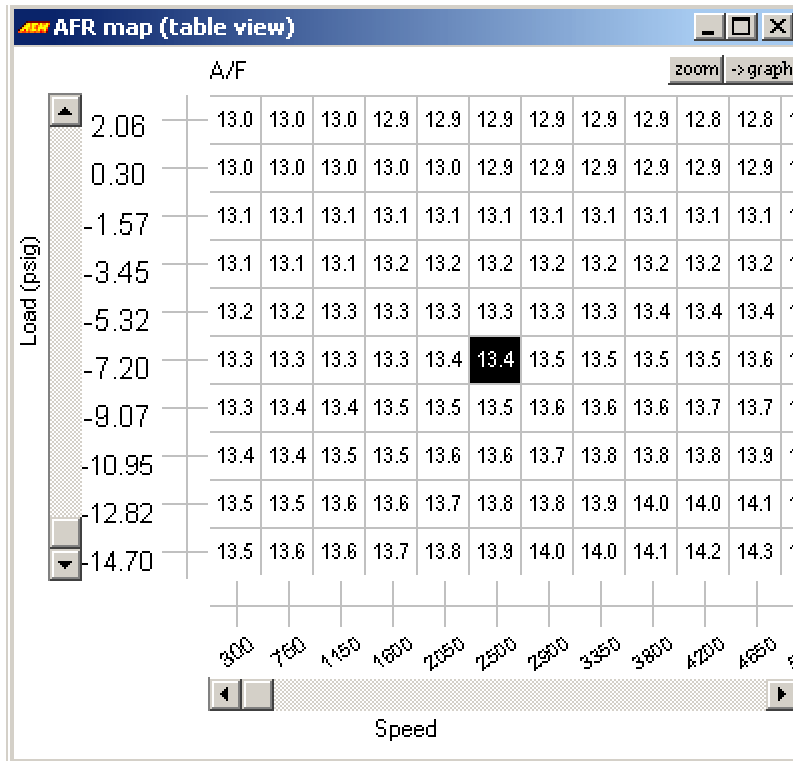
3-D Tables for O2 Feedback

AFR Map

Units: Engine Load vs. RPM vs. AFR

Description: O2 feedback target for specific engine loads and RPM.

Typical Use: The AFR map is used strictly for closed loop O2 feedback.



Parameters (can be viewed or logged)

O2 FB Delay

Units: Seconds

Description: Time delay for O2 feedback operation after engine start.

AFR Target

Units: AFR

Description: Air fuel ratio that directly corresponds with the AFR Map.

AFR #1

Units: AFR

Description: Scaled air fuel ratio from Lambda #1.

AFR Error#1

Units: AFR

Description: Difference between the actual air fuel ratio and the targeted air fuel ratio from Lambda #1.

O2 F.B.#1

Units: Fuel %

Description: The current amount of fuel implemented in order to reach the air fuel ratio target.

AFR #2

Units: AFR

Description: Scaled air fuel ratio from Lambda #2.

AFR Error#2

Units: AFR

Description: Difference between the actual air fuel ratio and the targeted air fuel ratio from Lambda #2.

O2 F.B.#2

Units: Fuel %

Description: The current amount of fuel implemented in order to reach the air fuel ratio target.

Switched Ignition Retard and Shift Cut Functions

The AEM EMS a 0 to 5 volt switched input that is typically used for a strain guage input switch. This works by setting up a high voltage and a low voltage, when the input exceeds the range of the selected voltage, the ignition may be cut or retarded. This setup is typically used for a sequentially shifted transmission to aid in the gear change process.

The S Swt is a Special software configured switch that is actually assigned as an input switch. This allows you to configure any analog channel with a switching point to activate ignition retard or cut for purposes such as Transmission shifting, Overboost protection, etc...

The following options are necessary for proper use of this function.

S Swt Analog in

Shift switch analog input channel. It appears on switches#2 when all active. Once all conditions have been met, it activates an internal channel (#10) that is broadcast in the EMS and can be used as a channel in for some sort of shift cut function.

S Swt High

Voltage threshold above which the Shift Cut function may be active.

S Swt Low

Voltage threshold at which the shift switch is determined to be off. Should be set lower than S Swt High.

S Swt Speed

Speed threshold that you must be above before the Shift Cut function may be on.

S Swt TP

Throttle threshold that you must be above before the Shift Cut function may be on.

SwtRtd adv

Advances the timing by this amount every 4.1 ms until the nominal timing is restored after the SwtRtd function is turned off. The timing amount is returned to normal in steps, not all at once. A larger number here returns the timing to the normal faster. Typical value is 1 degree.

SwtRtd in pin

Channel Input that your Timing Retard/Shift Cut function is input on.

SwtRtd Max

Total amount if Ignition retard desired while on the SwtRtd function.

SwtRtd ReArm

Time to wait after Timing Retard/Ig Cut is fully restored before allowing another SWRTD function to be recognized. Acts as a switch debounce. Typical value is 500 mS.

SwtRtd Rtd

Retards the timing by this amount every 4.1 ms until the total retard amount specified in SwtRtd Max is achieved. The timing amount is retarded in steps, not all at once. A larger number here retards the timing faster. Typical value is 1 degree.

SwtRtd Spark Cut

Activates the shift cut feature during SwtRtd. The ignition cut works with the ignition retard and only cuts the ignition after the full retard is achieved. After the SwtRtd function is deactivated by the switch, the timing is then advanced back to normal according to SwtRtd Adv and is re-armed after the time in SwtRtdReArm has elapsed.

SwtRtd Time

Max switch on time before it is assumed to be a failed switch input and kills the function.

Automatic Transmission Configuration

The AEM EMS is capable of extensive auto transmission control as long as the solenoids to be driven are compatible with the drivers in the AEM EMS. The automatic transmission control can be more complex than running an engine. There are several options and tables that apply to the Auto Trans control.

Note: It is important to determine the compatibility of the transmission solenoids with the AEM EMS, otherwise the EMS could be damaged

A/T CC Period

Frequency for converter clutch solenoid

A/T CC Valve

Channel assigned to be converter clutch output control

A/T CP Period

Frequency for converter clutch pressure solenoid

A/T CP Valve

Channel assigned to be converter clutch line pressure solenoid

A/T LP1 Period

Line pressure 1 frequency

A/T LP1 Valve

Channel assigned to be line pressure 1 valve

A/T LP2 Period

Line pressure 2 frequency

A/T LP2 Valve

Channel assigned to be line pressure 2 valve

A/T LP3 Period

Line pressure 3 frequency

A/T LP3 Valve

Channel assigned to be line pressure 3 valve

A/T S1 Period

Shift solenoid 1 frequency

A/T S1 Valve

Channel assigned to be shift solenoid 1

A/T S2 Period

Shift solenoid 2 frequency

A/T S2 Valve

Channel assigned to be shift solenoid 2

A/T S3 Period

Shift solenoid 3 frequency

A/T S3 Valve

Channel assigned to be shift solenoid 3

A/T Shaft Speed

Multiplier for setting shaft speed in rpm

A/T SS Spd in

Channel assigned to be input for input shaft

Gear 4 In pin

Input to use as Overdrive Gear 4 switch

Gear Auto/Man Toggle

Input to be used for selecting Auto Mode or Manual mode.

Gear control

This activates the automatic shift scheme.

Gear Drive

This specifies which gear lever position is to be used as drive.

Gear Hysteresis

This adds an upshift/downshift delay for smoother driving conditions

Gear Manual In pin

This selects what input will be used for manual gear selection.

Gear Manual Out pin

This is an optional output to trigger a light to warn that manual gear selection is engaged

GEARCMSK

Testing purposes,

Wide Open TP Off

When under this throttle position all gear changes will be made from the gear map.

Wide Open TP On

When above this throttle position all upshift gear changes will be made from the Gear WOT shift Table.

Auto Transmission tables

A/T SS1 Duty Table

This table is Duty% against gear position. 100% makes the solenoid active in that gear position 0% makes it inactive.

A/T SS2 Duty Table

This table is Duty% against gear position. 100% makes the solenoid active in that gear position 0% makes it inactive.

A/T TCC Duty Table

This table is Duty% against gear position. 100% makes the solenoid active in that gear position 0% makes it inactive.

A/T CP Duty Table

This table is Duty% against gear position. 100% makes the solenoid active in that gear position 0% makes it inactive.

A/T LP1 Duty Table

This table is Duty% against throttle position. Typically used for controlling line pressure against throttle position.

A/T LP2 Duty Table

This table is Duty% against throttle position. Typically used for controlling line pressure against throttle position.

Gear WOT Shift Table

This table defines the maximum allowable RPM to make the shift and is independently adjustable in each gear.

Gear Map

This 3d map is throttle against vehicle speed, and determines the shift schedule for the automatic transmission shift scheme. Enter the desired gear in each load and vehicle speed point, the EMS uses this as the lookup table to determine what gear the transmission should be in.

TP Angle

This table determines the “Y” axis points in the Gear map. Typically this is a linear line from 0 to 100%. This can be adjusted to alter the response of the shifting points.

Automatic Transmission Shift Retard Setup

You will need to address the following Options

SwtRtd Adv

This sets how many degrees of ignition advance get re-instated over the SwtRtd Time. Start with 7 degrees.

SwtRtd in pin

This is not used for Automatics. Setting the Gear Shift Retard to On bypasses this option. If using this from a switch input, you would select the input to activate these options. Should be Disabled.

SwtRtd Max

This sets the maximum allowable retard. Start with 15 degrees.

SwtRtd ReArm

This sets the amount of time before the shift retard can be re-activated. Start with 1050 ms.

SwtRtd Rtd

This sets the amount of retard in steps while in the retard mode. A higher number will reach the max retard faster, a lower number will reach the max retard slower. Start with 7 degrees.

SwtRtd Spark Cut

This option allows cutting of spark during the shift. Not recommended for Autotrans shifting. Typically used in a sequential gearbox application.

SwtRtd Time

This sets the amount of time for the retard to take place. This will vary with different transmissions. Try 250 ms

Gear Shift Retard

This option activates the shift retard options for the Automatic shifting.

Vehicle Speed (VSS) Configuration

Setting up the vehicle speed sensor is actually quite easy. Once setup, it can be logged and also used as a basis for speed dependant boost control.

To set it up, a few variables need to be set. Firstly, you must determine which channel the speed input is wired to. For plug and play applications, we usually put it in the T3 "Speedo" input. (T1 is Crank, T2 is Cam, T3 is Speedo and T4 is TDC).

To confirm that it is hooked up correctly, open AEMPro and connect to the ECU. With the wheel turning slowly, you should see the "T3" parameter alternating between on and off. If this is happening, you are wired correctly, if not, go back and recheck your wiring.

Once the T3 input is receiving the signal, you need to tell it what is significant about it, i.e., defining which edge matters. With VSS sensors, you should always use the falling edge of the signal. To do this, set T3 Fall to "ON". Now the ECU is seeing the signal, and it knows to act on the falling edge of the signal.

Now, you need to tell the EMS that T3 is the vehicle speed signal. There is a variable called "VSS Speed In" in which you put the channel that the VSS signal can be found on. Since this is T3, we should set VSS Speed In to T3.

Now, you need to scale the sensor so it reads your speed in a usable way. Display the Vehicle Speed parameter and start adjusting "Road Speed M" to scale the output. Make it bigger or smaller to adjust the calculated speed. If you make it as big as it gets but need more, then set VSS*8 to "ON". That will give you more adjustability.

Input Channel configuration

The AEM EMS allows for configuring the analog input channels to several functions/tables throughout the software for a completely custom setup. The following chart displays the analog channels available for selection

ANALOGUE INPUT

Name

ADCR1 (TPS Raw)
ADCR2 (MAP Raw)
ADCR3 (MAF Raw)
ADCR4 (Knock#1 Raw)
ADCR5 (Knock#2 Raw)
ADCR6 (AIT Raw)
ADCR7 (Cool Raw)
ADCR8 (Battery)
ADCR9 (Oxygen Raw#1)
ADCR10 (Oxygen Raw#2)
ADCR11 (PR Press Raw)
ADCR12 (Baro Raw)
ADCR13 (Gear Raw)
ADCR14 (Ftemp)
ADCR15 (EGT 3 Raw)
ADCR16 (EGT 4 Raw)
ADCR17 (EGT 1 Raw)
ADCR18 (EGT 2 Raw)
Vehicle speed
Engine Speed
Engine Load
MAP as Load
Throttle
MAF as Load
Injector Duty

There are several functions that can accept an analog channel as an input for configuration.

EGT #1-4 Analog in Pin

Typically these are assigned an EGT sensor, however they can be used for any input that you may wish to monitor or correct with fuel compensation. An example would be the following:

Dash mounted fuel trim switch

Setup a rotary switch to allow the driver to trim the fuel, +/-50 is available but a more prudent setting would be +/-10%

Fuel Pressure

Calibrate the EGT sensor table to be fuel pressure against voltage, and you can put a compensation in an EGT channel to add fuel if fuel pressure starts to drop.

Nitrous bottle Pressure

Calibrate the EGT sensor table to read your Nitrous bottle pressure, and fuel can be compensated with an EGT channel to subtract fuel as Nitrous bottle pressure goes down.

User #1 Analog in

By selecting an analog channel input, you can assign a duty output to a specified output channel against any analog input.

User #2 Analog in

By selecting an analog channel input, you can trim fuel +/- 50% against any analog input. This may be used for any fuel trim purpose against a 0 to 5volt input like the EGT analog input.

Setting up the switched output drivers

The AEM EMS has a total of 38 possible combinations for user output control. The number of injector drivers required to control injectors, and coil drivers required to control coils, will dictate the number of left over user definable driver outputs. These drivers can be configured with a number of different characteristics for precise control over a device.

The following is a list of options and software assignments to control each individual driver.

- A/C out pin – Set this to the driver# connected to the A/C clutch relay
- A/T CC Valve – Set this to the driver# connected to the Converter Lock up solenoid
- A/T CP Valve – Set this to the driver# connected to the Converter Clutch pressure solenoid.
- A/T LP1 Valve – Set this to the driver# connected to a Line pressure control solenoid
- A/T LP2 Valve – Set this to the driver# connected to a Line pressure control solenoid
- A/T LP3 Valve – Set this to the driver# connected to a Line pressure control solenoid
- A/T S1 Valve – Set this to the driver# connected to the appropriate shift solenoid.
- A/T S2 Valve – Set this to the driver# connected to the appropriate shift solenoid
- A/T S3 Valve – Set this to the driver# connected to the appropriate shift solenoid
- Gear Manual Out pin – Set this to the driver# connected to the Manual transmission mode light.
- Main Relay Out – Set this to the driver# connected to the Main relay.
- N2O Out Pin – Set this to the driver# connected to the Nitrous solenoid relay.
- Purge Valve #1 – Set this to the driver# connected to the purge control canister.
- Purge Valve #2 – Set this to the driver# connected to a secondary purge valve.
- Rev Light Out – Set this to the driver# connected to the Shift light.
- Tacho Pin – This is a special case number selection in that several drivers may be used to have an engine speed output.

It is a bit mask applied to the XPORTG channel. XPORTG channel is 8 bits representing the following outputs, in order: LS3,LS12,LS11,LS10,LS9,LS8,LS7,LS4

The tacho pin can be any one of these channels and is entered in the decimal equivalent of this binary value.

For example:

For the tacho to be output on LS3, set to 128

For the tacho to be output on LS12, set to 64

For the tacho to be output on LS11, set to 32

For the tacho to be output on LS10, set to 16

For the tacho to be output on LS9, set to 8

For the tacho to be output on LS8, set to 4

For the tacho to be output on LS7, set to 2

For the tacho to be output on LS4, set to 1

For it to be output on multiple pins, add the values together.

Example: for the tacho to be output on LS8 and LS12, set to 68 (4+64).

- User PWM Out – Set this to the driver# set to control from the User # 1 table.
Output Channel Driver #

Output pin	0=NONE	Notes
LS1	1	
LS2	2	
LS3	3	
LS4	4	
LS5	5	
LS6	6	
LS7	7	
LS8	8	
LS9	9	
LS10	10	
LS11	11	
LS12	12	
HS1	13	
HS2	14	
HS3	15	
HS4	16	
Injector1	17	
Injector2	18	
Injector3	19	
Injector4	20	
Injector5	21	
Injector6	22	
Injector7	23	
Injector8	24	
Injector9	25	
Injector10	26	
Coil1	27	
Coil2	28	
Coil3	29	
Coil4	30	Coil#4 must be off
Coil5	31	
FM	32	
PW1	33	IDLE PW = 7
PW2	34	WG PW = 7
IDLE1/2	35	check Idle1/2 I (must be set to 1.5)
IDLE3/4	36	check Idle3/4 I (must be set to 1.5)

		set to 1.5)
IDLE5/6	37	check Idle5/6 I (must be set to 1.5)
IDLE7/8	38	check Idle7/8 I (must be set to

EGT (RTD Only) Configuration

The AEM EMS is configured to accept RTD type Exhaust Gas Temperature sensors. This type of sensor is faster responding than conventional K-type thermocouple, and does not require special wire type or length.

EGT Sensors can be configured for monitoring, or feedback of the fuel system. The options that set up the EGT sensors are as follows:

EGT Control

This activates the EGT input. Set this to on if you have EGT Sensors connected to the AEM EMS.

EGT Default

This is the default reading if the EGT sensor goes out of the EGT min and max range.

EGT Max

This is the maximum allowable reading from the EGT Sensor before it goes to a faulty condition.

EGT Min

This is the minimum allowable reading from the EGT Sensor before it goes to a faulty condition.

EGT#1 Analog in

This assigns the input to read as EGT#1

EGT#2 Analog in

This assigns the input to read as EGT#2

EGT#3 Analog in

This assigns the input to read as EGT#3

EGT#4 Analog in

This assigns the input to read as EGT#4

Fuel 1 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 2 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 3 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 4 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 5 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 6 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 7 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 8 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 9 EGT

This option selects which EGT sensor will have control over this injector.

Fuel 10 EGT

This option selects which EGT sensor will have control over this injector.

The Tables that control the EGT sensor input and feedback loop are the following:

EGT Sensor Table

This table calibrates the input voltage from the sensor to the value that will be displayed at that voltage. If using the EGT sensor from AEM, a calibration chart is supplied.

EGT Fuel Table

This is the table for the feedback control of the EGT sensor against fuel to be added or subtracted. Note: When monitoring the EGT sensors only and no feedback is required this table must be set to zero.

Warning: Ignition timing plays a significant part in Exhaust Gas Temperature. High temperatures can be a result of retarded ignition timing as well as a lean condition in fuel mixture. Always use Oxygen sensor feedback in conjunction with EGT sensors to determine a proper engine tune.

Data Logger Configuration

The AEM EMS has very comprehensive datalogging capabilities, when properly used, the datalogging can save tuning time, and also help tremendously with engine component selection. There are 2 ways you can datalog with the AEM EMS, PC datalogging with the laptop connected will log for as long as you have hard drive space for the information to be stored. The AEM EMS also comes equipped with 512k of internal datalogging. This can be used separately or in addition to pc logging, then downloaded from the EMS with the PC.

Setting up the log names

The AEM EMS has an auto naming function that helps save time in automatically naming the files as you log. To configure this go to the menu Configure, then logging options, and there are 3 possibilities.

Manual

When in this mode, you need to enter a different name on each save event.

Date

When in this mode, the data logs will be saved by the date, with each iteration incrementing by a _001 , _002 etc..

Custom

When in this mode, you enter a custom name once, and each iteration will be incremented by a _001, _002, etc... Also if you type over the name as you save a new log, that name automatically becomes the default for your custom name, you do not have to go back in and re-configure your log options.

PC Datalogging

Parameters

The parameter window tells the EMS what information will be logged to the PC. The main menu has several sets of parameters set up by AEM for typical datalogs. Note: if no parameter window is displayed, no information will be logged. If more than one parameter window is open, the active window will be logged.

Locked

This button, located in the upper left corner of the parameter window, prevents the user from accidentally changing a parameter. Note: to change or add any parameters the lock button must be changed to read unlocked.

Update rate

When right clicking with the mouse button on a parameter, several options pop up in a menu, one of which is the update rate. Selecting this you will then get scale of fastest to slowest settings. The PC always logs the parameters as fast as possible. If there are numerous parameters being logged, then you can prioritize which ones are faster, and which ones are slower. For example, if 16 channels are being logged, then the PC will log each channel at the same fastest possible rate. IF you wish to assign some channels slower, and some channels faster, then the pc will prioritize it's speed ability accordingly. Typically the update rate is left in its default state.

Value

This displays a value only in the parameter window.

Bar

This fills the parameter window with a bar. This can help visually enhance determining where the specific parameter is in its range. Note: this also works in conjunction with the high and low limits

High limit

This sets the upper limit of the specific parameter before the parameter window fills in red as a warning.

Low limit

This sets the lower limit of the specific parameter before the parameter window fills in red as a warning.

Mix

This allows the combination of bar and value to be displayed in the parameter window.

Scope

This fills the parameter window with a scope like trace, so a brief history can be displayed.

Remove

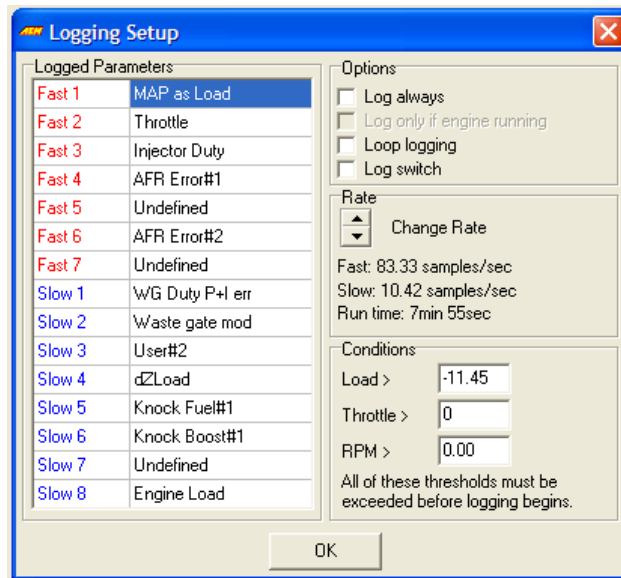
This removes the selected parameter. Note: the delete key will also perform this function.

Insert

This allows a parameter to be inserted between two parameters.

Internal Data logging

The internal data logging memory is 512k and varies in time duration dependant upon the logging sample rate, and channels selected. To setup the internal data logging first go the Setup menu, then select internal logging. There are 7 fast channels featuring recording rates of up to 250 times per second, and 8 slow channels, the log rate is displayed for the fast and slow channels separately, as well as the time duration that the log rate will allow.



Options

Log Always

This allows the internal log memory to be written to any time the key there is switched power to the EMS. Typically this is not used.

Log only if Engine running

This function is now controlled by the *Conditions* parameters.

Loop Logging

This allows the datalog to continually write over itself in a loop, keeping the most current data in memory.

Log Switch

This allows information to be written to the log memory only when a switch is active.

Rate

This function allows the user to change the rate at which the selected channels are recorded.

Note: The total logging time will be displayed here.

Conditions

This function allows the user to choose a set of conditions when the logger will start recording.

Load>

The engine load must exceed this value to activate logging.

Throttle>

The throttle position must exceed this value to activate logging.

RPM>

The engine rpm must exceed this value to activate logging.

Note: When using internal Data logging, all channels must have a parameter selected, or no logging will occur.

Saving the Datalog

When a log is completed with the PC, go to the logging menu, the select Stop and Save. You will then be prompted with the window for directing the file to be saved to, and the name. If you have the custom name, or date configured this will already have a name in the space to save with. If you choose to overwrite the name, you can do that as well.

You will then be prompted for notes to be entered. Enter any specific information that pertains to the datalog. I.E. added 5% fuel, etc. After the information has been entered, click on the close icon "x" box. Note: if no information has been entered, you can hit the return key until past this screen. All notes are then saved with the log file for later viewing.

Open the file in AEMLog for viewing (See: AEMLog users manual for manipulating and viewing data).

Glossary

A/F	Air fuel ratio, this is the number of air molecules to the number of fuel molecules. This is an expression that is determined by the mass of air to fuel.
AIT	Air inlet temperature sensor. This is used to measure inlet air temperature. The result of this measurement is used by the ECU to correct the fuel, and ignition curves for variances in inlet air density.
Bar	Another metric measurement of pressure, 1 bar is .987 atmosphere (See chart in ' <i>Fuel Injection Basics</i> '). Generally referred to as an absolute number.
Barometric Pressure Sensor	This is similar to the manifold pressure sensor (MAP), however this only measures atmospheric pressure. This sensor helps the ECU compensate fuel for altitude changes.
Batch Fire	This is when a group of injectors are fired simultaneously, regardless of cylinder position. With a batch fire system, the ability to control individual cylinder fueling is lost. Batch fire systems are adequate in most applications.
BSFC	Brake specific fuel consumption. This is the amount of fuel required (in lbs/hour) by the engine to make 1 horsepower/hour.
Cam Sensor	This sensor tells the ECU when top dead center of the number 1 cylinder is at the firing position (top of compression stroke). This allows correct sequencing for DIS systems and sequential injection.
Crank Angle Sensor	This is the sensor that tells the ECU the crank angle. It is used for timing input.
Delay Angle	This is the number that is determined by the difference between actual timing displayed

	with a timing light, and the timing advance displayed on the screen of the lap top. Used to synchronize the computer with actual ignition timing.
Direct Fire Ignition	Distributorless ignition with an individual coil for each plug.
DIS	Distributorless Ignition System.
Dry Nitrous System	Injects only Nitrous through a nozzle, the fuel is added independently of the nitrous system. Usually the additional fuel is injected through the injectors by increasing the opening time (pulse width) of the injector.
ECU	Engine control unit. This is the computer that controls the engines functions.
EFI	Electronic fuel injection.
EGT	Exhaust gas temperature. Used to measure the temperature of the exhaust.
High Impedance Injectors	This helps give the tuner an idea of how the fuel is burning, however it does not directly relate to Rich/Lean mixture. Timing affects this dramatically. This is an injector with a resistance of 7 ohms or higher. The common high impedance injector has 16 ohms, and is known as Saturated type injectors.
HS	High side circuit. This is a circuit that outputs 12 volts to a device. The HS drivers in the AEM ECU are capable of outputting 12V at 4.5 amps. A typical device that would be driven by a HS driver is VTEC or nitrous oxide solenoids.
IAC	Idle air control, most late model fuel injected cars are equipped with a solenoid or stepper motor to control idle conditions and help prevent stalling under varying engine loads at idle. These loads are encountered when air conditioning is turned on or when the transmission is put in drive.
Knock	This is also known as detonation, this happens when the combustion charge ignites too early in the compression cycle and causes a rattling sound or pinging sound. By the time knocking is audible engine damage is imminent. Conservative ignition timing, fuel mixtures, and adequate octane fuel should be used to prevent this situation.
Kpa	Kilopascal. Metric measurement of pressure, 101.325 Kpa is equal to 1 atmosphere. 1 atmosphere is equal to 14.7 pounds per square inch. 100 KPA is 1 bar. See chart in 'Fuel Injection Basics'.
Low Impedance Injectors	This is an injector with a resistance of less than 7 ohms of resistance, also known as peak/hold injectors.
LS	Low side circuit. This is also known as a "pull to ground" circuit. LS circuits have power supplied through the device and the driver grounds the circuit to complete the electrical path. An example of this would be a shift light that would be activated by a LS circuit. The maximum current that can be run on the LS driver is 1.5 amps.
Map Sensor	Manifold absolute pressure sensor. These sensors are typically 1 bar (for non-turbo engines) to 3 bar (turbo) sensors.
Mass Air Flow Meter	This is used to calculate airflow into the engine. Normally used instead of a manifold pressure sensor.
O2 Sensor	Exhaust gas oxygen sensor.
Port Injection	This is when the injector fires directly into each intake port for each cylinder.
Static	This is when the fuel injectors have achieved an always-open status, which happens when the injector open signal is long enough, and the speed of the engine is such that the injector has received another open signal before it closes.
TBI	Throttle body injection. These systems have injectors firing into a throttle body, similar to a carburetor, instead of firing directly into the intake port on the cylinder head.
Template	This is a user defined screen layout. The layout can consist of tuning tools such as fuel or ignition maps, monitored engine functions, or any ECU options. Through the use of template buttons, the tuner can easily switch between displayed tuning functions.
TPS	Throttle position sensor. This sensor is used to detect throttle input angle.
UEGO	This is a high-speed wide band oxygen sensor. As of the printing of this manual, it is the most accurate oxygen sensor available. They read accurately from 9:1 to 30:1 air fuel ratios.
Wasted Spark	Distributorless ignition with one shared between 2 cylinders. This system fires two sparkplugs each ignition event, one plug on its compression cycle, one on exhaust cycle.
Wet Nitrous System	Nitrous system that also adds fuel with the Nitrous injected through a nozzle.

AEMPro File Types

.aem	AEMPro executable software for the user interface.
.dgt	Template file for screen templates used in AEMLog.
.dll	Dynamic link library.
.dsh	Dash file for dashboards used in AEMPro Software.
.fin	Firmware for the AEM ECU. This is the software that needs updating whenever the ECU gets updated with new features. The latest features are available via the AEM website.
.gdf	Calibration file. This file contains the information that is used in the various maps and options for a specific vehicle.
.gin	This is the software that provides the communication between the firmware and the user interface. These files contain information for metric and standard units of measure, various menu options etc.
.gtp	Template file for screen templates used in AEMPro.
.stf	Log files used in AEMLog. This is the data captured when performing data logging.
.mxx	Menu file created when setting up custom menus in AEMPro.

AEMPro Options List Definitions

1/2 Tooth IR	Yes/No	Used to increase the ignition resolution on engines with a very small number of cam and crank teeth. (DSM's)
A/C in pin	Input Channel	Channel to be used for a/c request
A/C Off TP	%	When above this throttle position the a/c will be deactivated if on
A/C out pin	Output Driver Channel	Channel to be used to engage a/c compressor clutch
A/T CC Period	mS	Frequency for converter clutch solenoid
A/T CC Valve	Output Driver Channel	Channel assigned to be converter clutch output control
A/T CP Period	mS	Frequency for converter clutch pressure solenoid
A/T CP Valve	Output Driver Channel	Channel assigned to be converter clutch line pressure solenoid
A/T LP1 Period	mS	Line pressure 1 frequency
A/T LP1 Valve	Output Driver Channel	Channel assigned to be line pressure 1 valve
A/T LP2 Period	mS	Line pressure 2 frequency
A/T LP2 Valve	Output Driver Channel	Channel assigned to be line pressure 2 valve
A/T LP3 Period	mS	Line pressure 3 frequency
A/T LP3 PG Mask	bits	Leave at 0
A/T LP3 Valve	Output Driver Channel	Channel assigned to be line pressure 3 solenoid
A/T LP3*Lock	%	Sets rate of locking the torque converter by the lockup map
A/T S1 Period	mS	Shift solenoid 1 frequency
A/T S1 Valve	Output Driver Channel	Channel assigned to be shift solenoid 1
A/T S2 Period	mS	Shift solenoid 2 frequency
A/T S2 Valve	Output Driver Channel	Channel assigned to be shift solenoid 2
A/T S3 Period	mS	Shift solenoid 3 frequency
A/T S3 Valve	Output Driver Channel	Channel assigned to be shift solenoid 3
A/T Shaft Speed M	RPM	Multiplier for setting shaft speed in rpm
A/T SS Spd in	Input Channel	Channel assigned to be input for input shaft
Accel Decay	%	Determines the rate at which the accel fuel goes away. Actual formula used is current accel fuel * this number, each engine revolution. A larger number makes the accel fuel stay longer.
Accel Fuel Min	uS	O2 feedback threshold for accel fuel. Current accel fuel amount must be below this value for the O2 Feedback to operate
Accel Limit	%	Maximum accel fuel allowed to be added. The software "clamps" the accel component to this value no matter how high the calculated value is

Accel Load Trig	%	When the change in MAP (dMAP) exceeds this value, accel fuel can be added. This acts as a minimum load change threshold for accel fuel.
Accel O2FB Inhibit	mS	Time after accel function action for the O2 F/B system to wait before re-enabling
Accel TP Trig	%	When the change in TP (dTP) exceeds this value, accel fuel can be added. This acts as a minimum TPS change threshold for accel fuel.
AF High	%	If flow sum c exceeds this value then the Load will be taken from the TPS to Load table. (used with Vortex type MAF sensors)
AF Low	%	If flow sum c is less than this value then the Load will be taken from the TPS to Load table. (used with Vortex type MAF sensors)
AF REV	Crank Revolutions	Determines over how many crank engine cycles are used to average the flow pulses. Valid numbers are 2 to 6. (used with Vortex type MAF sensors)
AFR#1 Lean Limit	A/F Ratio	This is the maximum value allowed before the warning light may be triggered.
AFR#1 Rich Limit	A/F Ratio	This is the minimum value allowed before the warning light may be triggered.
AFR#2 Lean Limit	A/F Ratio	This is the maximum value allowed before the warning light may be triggered.
AFR#2 Rich Limit	A/F Ratio	This is the minimum value allowed before the warning light may be triggered.
Air Default	Deg	Desired air temp reading when air temp sensor is in default
Air Temp max	Deg	Maximum allowable air temp number before the sensor is considered faulty
Air Temp min	Deg	Minimum allowable air temp number before the air temp sensor is considered faulty
Alt Fuel	%	Percentage of fuel to be added when in the alternate switched condition
Alt in pin	Input Channel	Channel to activate the alternate trims
Alt Load OFF	%	When above this load value the alternate trims will be deactivated
Alt Load ON	%	When above this load value but below the "Alt Load Off" value, the alternate trims will be activated
Alt Out Pin	Output Driver Channel	If the Alt function is activated, this output channel will be activated also. Can be used to drive an LED, injector or whatever.
Alt Spark	Deg	Amount of ignition spark to be trimmed (+/-) when the alternate trims are active
Alt Speed OFF	RPM	When above this rpm, the alternate trims and functions will deactivate
Alt Speed ON	RPM	When above this rpm, but below the "Alt Speed Off" rpm, the alternate trims and functions will activate
Alt TPS OFF	%	When below this throttle position the alternate trims will be inactive. Should be lower than "Alt TPS ON" value.
Alt TPS ON	%	When above this throttle position the alternate trims and functions will activate. Should be higher than "Alt TPS OFF" value.
Anti-Lag Control	On/Off	Activates the turbo Anti-Lag function
Auto EE	On/Off	When turned on, the calibrations made live will automatically be stored into the EMS. Always leave this "On"
BAR/INP	On/Off	Turns on and off Baro pressure sensor input
Baro Default	KPa	When the barometric pressure sensor is in default, this value will be used
Baro kPa C	Gain Multiplier	This is the gain for calibrating the Baro sensor. $\text{Baro kPa} = \text{Raw} * \text{Gain} + \text{Offset}$
Baro kPa K	KPa	This is the offset for calibrating the Baro sensor. $\text{Baro kPa} = \text{Raw} * \text{Gain} + \text{Offset}$
Baro max	KPa	Maximum pressure the Baro sensor is capable of reading (set from AEM)
Baro min	KPa	Minimum pressure the Baro sensor is capable of reading (set from AEM)
Boost FB VSS	On/Off	Activates the boost control against vehicle speed
Boost from Load	On/Off	Sets whether the boost control target is based on the load value or the MAP value. On MAF sensor equipped cars, the load is not the MAP sensor input but the mass airflow. If you are boosting, and you are using a MAF as your load input, set this to "Off" to target your boost control from your MAP sensor. Set this to "On" if you want to control boost to you MAF sensor readings. If you don't have a MAF sensor or are not boosting, set it to "Off"
Boost SW in pin	Input Channel	You have the option of an alternate boost level controlled by a switch input. This sets the channel in location where this input is coming.
Boost SW Target	KPa	When the Boost SW is activated, this new fixed boost target is activated,

Cam = T4	On/Off	Used only when the cam sensor is routed to the timing 4 input
Coil #1	On/Off	turns on and off the coil #1 driver as a coil output
Coil #10	On/Off	turns on and off the coil #10 driver as a coil output
Coil #2	On/Off	turns on and off the coil #2 driver as a coil output
Coil #3	On/Off	turns on and off the coil #3 driver as a coil output
Coil #4	On/Off	turns on and off the coil #4 driver as a coil output
Coil #5	On/Off	turns on and off the coil #5 driver as a coil output
Coil #6	On/Off	turns on and off the coil #6 driver as a coil output
Coil #7	On/Off	turns on and off the coil #7 driver as a coil output
Coil #8	On/Off	turns on and off the coil #8 driver as a coil output
Coil #9	On/Off	turns on and off the coil #9 driver as a coil output
Coil Factor		This factor adjusts the charge time for each coil. Typically, standard ignition systems require a value of 20 while CD ignition systems use only about 10. Too high a charge time will overheat the coil and in some cases will not allow the coil to fully discharge between firings. If you experience misfire due to a lack of ignition system energy, this can be raised in small increments to achieve higher saturation of the coils.
Coil(1-10) Alt Dwell	On/Off	Used only on Rotary engines (See Rotary setup)
Coil(1-10) Knock1	On/Off	Because there are provisions for two knock sensors, individual coils can be assigned to either knock sensor. Typically on V-engines, one sensor is on each bank. The tuner can assign the appropriate sensor to the coils that control the respective banks of the engine. This is the primary knock sensor channel.
Coil(1-10) Knock2	On/Off	Because there are provisions for two knock sensors, individual coils can be assigned to either knock sensor. Typically on V-engines, one sensor is on each bank. The tuner can assign the appropriate sensor to the coils that control the respective banks of the engine. This is the secondary knock sensor channel.
Coil(1-10) Lead	On/Off	This assigns this driver to get its values from the main ignition table
Coil(1-10) Trail	On/Off	This assigns the driver to its values from the secondary ignition table. Rotaries only.
Coil(1-5) AFR	On/Off	This activates the output when the AFR exceeds either the AFR#1 min or AFR#1 max values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
Coil(1-5) AltSwt	On/Off	This allows the user to activate this output circuit via a switch input. An example of this would be for a nitrous oxide solenoid. All of the operational parameters defined in the setup must be met before the ECU becomes active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
Coil(1-5) Cool	Deg C	The engine coolant temperature at which the output circuit is triggered to be active or not depending on the "Cool Hi" Selection.
Coil(1-5) Cool Hi	On/Off	This is the switch to activate or deactivate the output circuit based on the engine coolant temperature. When the switch is "OFF", then the engine coolant temperature which the circuit becomes active is below the "Cool" value. When the switch is "ON", the engine coolant temperature at which the circuit becomes active is above the "Cool" value. This is usually used to drive the radiator fans. The "Cool Hi" value must also be set to the appropriate value.
Coil(1-5) Fuel Pump	On/Off	When active this makes this output driver emulate the traits of a fuel pump. Both the "HS Func Status" and the "HS Alt" switches must also be "On" for this function to work.
Coil(1-5) Func Status	On/Off	When on, the output can be used as a specific output function. I.E. fuel pump with priming. After this is enabled, the specific function (AFR, ALTSwt, RevLimit2, SwtRtd, VTEC or Fuel Pump) must also be enabled.
Coil(1-5) Load	%	The engine Load (Y-axis on the map) at which the output is triggered to be active or not depending on the Load Hi Selection.

Coil(1-5) Load Hi	On/Off	This defines if the output should be activated when the engine load exceeds the outputs Load value or when the engine load is below the outputs Load value. Setting the switch to "On" makes the circuit becomes active when the load is above the outputs Load threshold.
Coil(1-5) RevLimit2	On/Off	Setting this value to "On" will enable this output when the engine is under the control of RevLimit2 (the secondary rev limiter, activated by a switched input, commonly called a two step limit). This should not be used to enable the driver if the device is to be driven off of the normal (higher) rev limit. That is much easier to define by simply setting the outputs Speed and Speed Hi values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
Coil(1-5) Speed	RPM	The engine speed (X-axis on the map) at which this output circuit is triggered to be active or not depending on the Speed Hi Selection.
Coil(1-5) Speed Hi	On/Off	This defines if the output should be activated when the engine speed exceeds the Speed value or when the speed is below the Speed value. Setting the switch to "On" makes the circuit becomes active when the speed is above the Speed value.
Coil(1-5) Switch	Input Channel	Channel to be used as switch input to activate this driver
Coil(1-5) SwtRtd	On/Off	An external switch can be set up to use a timing map that retards the ignition timing (typically used for boost enhancement at vehicle launch). If this is in use, this can also be used as an activation criteria to drive an output. Setting this variable "On" will activate this output when the SwtRtd function is active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
Coil(1-5) TP	%	The throttle position (Y-axis on the map) at which the output is triggered to be active or not depending on the TP Hi Selection.
Coil(1-5) TP Hi	On/Off	This defines if the output should be activated when the throttle position exceeds the outputs TP value or when the throttle position is below the HS TP value. Setting the switch to "On" makes the circuit becomes active when the throttle position is above the outputs TP value.
Coil(1-5) VTEC	On/Off	Setting this to "On" enables this output when the VTEC criteria is met. These are set in the VTEC section. Both the "HS-Func Status" and "HS-Alt" switches must also be "On" for this function to work.
Coil(1-5)Alt	On/Off	This turns the output circuit on or off. Off-non active, on-active. Note that when an output circuit is used for a function it becomes dedicated to that function. In other words, the same circuit cannot drive the VTEC solenoid and the shift light simultaneously. The circuits are switches activated when the criteria set in the parameters below are met.
Coolant Default	C	This is the value for the coolant sensor when in the default condition
Coolant max	C	This is the maximum value for the coolant sensor before it is considered faulty
Coolant min	C	This is the minimum value for the coolant sensor before it is considered faulty
Crank Adv	Deg	This is the ignition timing to be used in the cranking condition
Crank Alt Fire	On/Off	This is for wasted spark engines with properly spaced crank teeth for rapid starting
Crank exit	RPM	This is the rpm at which the computer exits the cranking condition
Crank Lead Edge	On/Off	This option sets which edge is to be considered for timing reference (typically only used on Mitsubishi timing pickups)
Crank Min	RPM	This is the minimum engine speed before any fuel or spark will be delivered to the engine
Cycle/Rev	On/Off	This is used on 2 stroke engines and certain timing patterns to display proper engine speed
Decel Decay	%	Determines the rate at which the decel fuel comes back. Actual formula used is current decel fuel * this number, each engine revolution. A larger number makes the decel fuel removed leave faster. Typical is 50%
Decel O2FB Inhibit	mS	Time after decel function action for the O2 F/B system to wait before re-enabling
Decel TP Trig	Deg	This is the throttle position at which to trigger decel fuel
DFCO Load	%	This is the load at which when below to trigger decel fuel cut

DFCO Speed	RPM	This is the engine speed at when above to enable decel fuel cut
DFCO Throttle	%	This is the throttle position at which when below to enable decel fuel cut
Diff SW in pin	Input Channel	This assigns an input channel to activate fuel and ignition difference maps. See also "Fuel Diff" and "IGN Diff"
Dwell Alt mod	%	Rotary only. 2 different specs of coil. (multiplier for 2nd dwell charge time)
Dwell Max	Teeth (Crank Deg)	This is the maximum time between coil charging in crank teeth. A large number allows more available time to charge the coil while a smaller number allows less time to charge. The charge time is dictated by the type of ignition system being used. CD Ignition systems typically require less time than standard systems. This is the "ON" time of the coil.
Dwell Min	Teeth (Crank Deg)	This is the time between coil charging in crank teeth. A small number allows more time between each charge while a larger number allows less time. The charge time is dictated by the type of ignition system being used. CD Ignition systems typically require less time than standard systems. This is the "OFF" time of the coil.
Early Sync	On/Off	Tries to get the ECU to sync up and start the engine quicker. Default is Off.
EGT control	On/Off	This activates EGT feedback
EGT Default	deg C	When in default, this value will be used if EGT feedback is active
EGT max	deg C	This is the maximum value for the EGT sensor before it is considered faulty
EGT min	deg C	This is the minimum value for the EGT sensor before it is considered faulty
EGT#1 Analog in	Input Channel	This is the input pin for the EGT#1 feedback control
EGT#2 Analog in	Input Channel	This is the input pin for the EGT#2 feedback control
EGT#3 Analog in	Input Channel	This is the input pin for the EGT#3 feedback control
EGT#4 Analog in	Input Channel	This is the input pin for the EGT#4 feedback control
Flow Max		Scales Flow sum c into 0-130 for Airflow and Load if MAF and MAF Vortex = On. (used with Vortex type MAF sensors) typical value is 40 to 50
FM AFR	On/Off	This activates the output when the AFR exceeds either the AFR#1 min or AFR#1 max values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
FM Alt	On/Off	This turns the output circuit on or off. Off-non active, on-active. Note that when an output circuit is used for a function it becomes dedicated to that function. In other words, the same circuit cannot drive the VTEC solenoid and the shift light simultaneously. The circuits are switches activated when the criteria set in the parameters below are met.
FM AltSwt	On/Off	This allows the user to activate this output circuit via a switch input. An example of this would be for a nitrous oxide solenoid. All of the operational parameters defined in the setup must be met before the ECU becomes active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
FM Cool	deg C	The engine coolant temperature at which the output circuit is triggered to be active or not depending on the "Cool Hi" Selection.
FM Cool Hi	On/Off	This is the switch to activate or deactivate the outpu circuit based on the engine coolant temperature. When the switch is "OFF", then the engine coolant temperature which the circuit becomes active is below the "Cool" value. When the switch is "ON", the engine coolant temperature at which the circuit becomes active is above the "Cool" value. This is usually used to drive the radiator fans. The "Cool Hi" value must also be set to the appropriate value.
FM Fuel Pump	On/Off	When active this makes this output driver emulate the traits of a fuel pump. Both the "HS Func Status" and the "HS Alt" switches must also be "On" for this function to work.
FM Func Status	On/Off	When on, the output can be used as a specific output function. I.E. fuel pump with priming. After this is enabled, the specific function (AFR, ALTSwt, RevLimit2, SwtRtd, VTEC or Fuel Pump) must also be enabled.

FM Load	%	The engine Load (Y-axis on the map) at which the output is triggered to be active or not depending on the Load Hi Selection.
FM Load Hi	On/Off	This defines if the output should be activated when the engine load exceeds the outputs Load value or when the engine load is below the outputs Load value. Setting the switch to "On" makes the circuit becomes active when the load is above the outputs Load threshold.
FM RevLimit2	On/Off	Setting this value to "On" will enable this output when the engine is under the control of RevLimit2 (the secondary rev limiter, activated by a switched input, commonly called a two step limit). This should not be used to enable the driver if the device is to be driven off of the normal (higher) rev limit. That is much easier to define by simply setting the outputs Speed and Speed Hi values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
FM Speed	RPM	The engine speed (X-axis on the map) at which this output circuit is triggered to be active or not depending on the Speed Hi Selection.
FM Speed Hi	On/Off	This defines if the output should be activated when the engine speed exceeds the Speed value or when the speed is below the Speed value. Setting the switch to "On" makes the circuit becomes active when the speed is above the Speed value.
FM Switch	Input Channel	Channel to be used as switch input to activate this driver
FM SwtRtd	On/Off	An external switch can be set up to use a timing map that retards the ignition timing (typically used for boost enhancement at vehicle launch). If this is in use, this can also be used as an activation criteria to drive an output. Setting this variable "On" will activate this output when the SwtRtd function is active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
FM TP	%	The throttle position (Y-axis on the map) at which the output is triggered to be active or not depending on the TP Hi Selection.
FM TP Hi	On/Off	This defines if the output should be activated when the throttle position exceeds the outputs TP value or when the throttle position is below the HS TP value. Setting the switch to "On" makes the circuit becomes active when the throttle position is above the outputs TP value.
FM VTEC	On/Off	Setting this to "On" enables this output when the VTEC criteria is met. These are set in the VTEC section. Both the "HS-Func Status" and "HS-Alt" switches must also be "On" for this function to work.
Fuel cut	RPM	This is the RPM to enter fuel cut as part of the rev limiter
Fuel Cut +	%	If the RPM exceeds 50 rpm over the rev limit, this additional Fuel Cut Rate is added to the Fuel Cut Rate.
Fuel cut 2nd	RPM	This is the RPM to enter the secondary fuel cut rev limiter
Fuel cut rate	%	This is the amount of fuel to cut when in the fuel cut condition
Fuel Diff	On/Off	When on, the secondary fuel table will be active for the staged injection
Fuel Diff Map	3D Offset Map	If the "Fuel Dif" option is "On" this map is used to determine the % of fuel that will be routed through the secondary injectors. The "Secondary" injector flow multiplier is used to scale the pulse width to the appropriate value.
Fuel Map Throttle	On/Off	Flag for setting the Ignition map based off of the MAP sensor (On) or engine load (Off)
Fuel Teeth	Teeth (Crank Deg)	This is the number of teeth on the trigger device that determines a complete engine cycle. (Two rotations of the crankshaft on a four-stroke engine) If there were, a 24-tooth wheel mounted on the crankshaft then there would be 48 teeth per cycle. If there were, a 24-tooth wheel mounted on the distributor or camshaft then there would be 24 teeth per cycle.
Fuel(1-10) AFR	On/Off	This activates the output when the AFR exceeds either the AFR#1 min or AFR#1 max values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.

Fuel(1-10) Alt	On/Off	This turns the output circuit on or off. Off-non active, on-active. Note that when an output circuit is used for a function it becomes dedicated to that function. In other words, the same circuit cannot drive the VTEC solenoid and the shift light simultaneously. The circuits are switches activated when the criteria set in the parameters below are met.
Fuel(1-10) AltSwt	On/Off	This allows the user to activate this output circuit via a switch input. An example of this would be for a nitrous oxide solenoid. All of the operational parameters defined in the setup must be met before the ECU becomes active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
Fuel(1-10) Cool	deg C	The engine coolant temperature at which the output circuit is triggered to be active or not depending on the "Cool Hi" Selection.
Fuel(1-10) Cool Hi	On/Off	This is the switch to activate or deactivate the output circuit based on the engine coolant temperature. When the switch is "OFF", then the engine coolant temperature which the circuit becomes active is below the "Cool" value. When the switch is "ON", the engine coolant temperature at which the circuit becomes active is above the "Cool" value. This is usually used to drive the radiator fans. The "Cool Hi" value must also be set to the appropriate value.
Fuel(1-10) EGT	On/Off	This assigns the driver to respond from a specific egt sensor for feedback control
Fuel(1-10) Fuel Pump	On/Off	When active this makes this output driver emulate the traits of a fuel pump. Both the "HS Func Status" and the "HS Alt" switches must also be "On" for this function to work.
Fuel(1-10) Func Status	On/Off	When on, the output can be used as a specific output function. I.E. fuel pump with priming. After this is enabled, the specific function (AFR, ALTSwt, RevLimit2, SwtRtd, VTEC or Fuel Pump) must also be enabled.
Fuel(1-10) Knock1	On/Off	This assigns this driver to respond to knock 1 feed back
Fuel(1-10) Knock2	On/Off	This assigns this driver to respond to knock 2 feedback
Fuel(1-10) Load	%	The engine Load (Y-axis on the map) at which the output is triggered to be active or not depending on the Load Hi Selection.
Fuel(1-10) Load Hi	On/Off	This defines if the output should be activated when the engine load exceeds the outputs Load value or when the engine load is below the outputs Load value. Setting the switch to "On" makes the circuit becomes active when the load is above the outputs Load threshold.
Fuel(1-10) O2FB1	On/Off	This assigns this driver to respond to Oxygen 1 feed back
Fuel(1-10) O2FB2	On/Off	This assigns this driver to respond to Oxygen 2 feedback
Fuel(1-10) Primary	On/Off	This assigns the driver to act as the primary injector driver. It can be left off in staged injection is not used. If secondary injectors are going to be used, both primary and secondary injectors must be defined.
Fuel(1-10) RevLimit2	On/Off	Setting this value to "On" will enable this output when the engine is under the control of RevLimit2 (the secondary rev limiter, activated by a switched input, commonly called a two step limit). This should not be used to enable the driver if the device is to be driven off of the normal (higher) rev limit. That is much easier to define by simply setting the outputs Speed and Speed Hi values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
Fuel(1-10) Secondary	On/Off	This assigns the driver to act as the secondary injector driver. It can be left off in staged injection is not used. If secondary injectors are going to be used, both primary and secondary injectors must be defined.
Fuel(1-10) Speed	RPM	The engine speed (X-axis on the map) at which this output circuit is triggered to be active or not depending on the Speed Hi Selection.
Fuel(1-10) Speed Hi	On/Off	This defines if the output should be activated when the engine speed exceeds the Speed value or when the speed is below the Speed value. Setting the switch to "On" makes the circuit becomes active when the speed is above the Speed value.
Fuel(1-10) Switch	Input Channel	Channel to be used as switch input to activate this driver

Fuel(1-10) SwtRtd	On/Off	An external switch can be set up to use a timing map that retards the ignition timing (typically used for boost enhancement at vehicle launch). If this is in use, this can also be used as an activation criteria to drive an output. Setting this variable "On" will activate this output when the SwtRtd function is active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
Fuel(1-10) TP	%	The throttle position (Y-axis on the map) at which the output is triggered to be active or not depending on the TP Hi Selection.
Fuel(1-10) TP Hi	On/Off	This defines if the output should be activated when the throttle position exceeds the outputs TP value or when the throttle position is below the HS TP value. Setting the switch to "On" makes the circuit becomes active when the throttle position is above the outputs TP value.
Fuel(1-10) VTEC	On/Off	Setting this to "On" enables this output when the VTEC criteria is met. These are set in the VTEC section. Both the "HS-Func Status" and "HS-Alt" switches must also be "On" for this function to work.
Gear 4 In pin	Input Channel	A/T overdrive input to ECU
Gear Auto/Man Toggl	On/Off	A/T Specific
Gear control	On/Off	A/T specific, enables auto gearbox. On for auto trans, off for standard
Gear Drive	Gear Number	A/T specific, specify gear above which the ECU can simply use the drive mode
Gear Hysteresis	On/Off	A/T specific, doesn't work well but is benign. Base is Off.
Gear Manual In pin	Input Channel	A/T specific, selects the switch input which will define if you are in manual override mode
Gear Manual Out pin	Output Driver Channel	A/T specific, drives the manual/auto dash light
Gear Shift Retard	On/Off	If on, when the A/T is changing gears, this will activate the swrtd function.
GEARCMSK		Supra specific, gear change mask. 0 means no wait for valve to go to 0 before going to the next gear. 255 means wait.
HS(1-4) AFR	On/Off	This activates the output when the AFR exceeds either the AFR#1 min or AFR#1 max values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
HS(1-4) Alt	On/Off	This turns the output circuit on or off. Off-non active, on-active. Note that when an output circuit is used for a function it becomes dedicated to that function. In other words, the same circuit cannot drive the VTEC solenoid and the shift light simultaneously. The circuits are switches activated when the criteria set in the parameters below are met.
HS(1-4) AltSwt	On/Off	This allows the user to activate this output circuit via a switch input. An example of this would be for a nitrous oxide solenoid. All of the operational parameters defined in the setup must be met before the ECU becomes active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
HS(1-4) Cool	deg C	The engine coolant temperature at which the output circuit is triggered to be active or not depending on the "Cool Hi" Selection.
HS(1-4) Cool Hi	On/Off	This is the switch to activate or deactivate the output circuit based on the engine coolant temperature. When the switch is "OFF", then the engine coolant temperature which the circuit becomes active is below the "Cool" value. When the switch is "ON", the engine coolant temperature at which the circuit becomes active is above the "Cool" value. This is usually used to drive the radiator fans. The "Cool Hi" value must also be set to the appropriate value.
HS(1-4) Fuel Pump	On/Off	When active this makes this output driver emulate the traits of a fuel pump. Both the "HS Func Status" and the "HS Alt" switches must also be "On" for this function to work.
HS(1-4) Func Status	On/Off	When on, the output can be used as a specific output function. I.E. fuel pump with priming. After this is enabled, the specific function (AFR, ALTSwt, RevLimit2, SwtRtd, VTEC or Fuel Pump) must also be enabled.
HS(1-4) Load	%	The engine Load (Y-axis on the map) at which the output is triggered to be active or not depending on the Load Hi Selection.

HS(1-4) Load Hi	On/Off	This defines if the output should be activated when the engine load exceeds the outputs Load value or when the engine load is below the outputs Load value. Setting the switch to "On" makes the circuit becomes active when the load is above the outputs Load threshold.
HS(1-4) RevLimit2	On/Off	Setting this value to "On" will enable this output when the engine is under the control of RevLimit2 (the secondary rev limiter, activated by a switched input, commonly called a two step limit). This should not be used to enable the driver if the device is to be driven off of the normal (higher) rev limit. That is much easier to define by simply setting the outputs Speed and Speed Hi values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
HS(1-4) Speed	RPM	The engine speed (X-axis on the map) at which this output circuit is triggered to be active or not depending on the Speed Hi Selection.
HS(1-4) Speed Hi	On/Off	This defines if the output should be activated when the engine speed exceeds the Speed value or when the speed is below the Speed value. Setting the switch to "On" makes the circuit becomes active when the speed is above the Speed value.
HS(1-4) Switch	Input Channel	Channel to be used as switch input to activate this driver
HS(1-4) SwtRtd	On/Off	An external switch can be set up to use a timing map that retards the ignition timing (typically used for boost enhancement at vehicle launch). If this is in use, this can also be used as an activation criteria to drive an output. Setting this variable "On" will activate this output when the SwtRtd function is active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
HS(1-4) TP	%	The throttle position (Y-axis on the map) at which the output is triggered to be active or not depending on the TP Hi Selection.
HS(1-4) TP Hi	On/Off	This defines if the output should be activated when the throttle position exceeds the outputs TP value or when the throttle position is below the HS TP value. Setting the switch to "On" makes the circuit becomes active when the throttle position is above the outputs TP value.
HS(1-4) VTEC	On/Off	Setting this to "On" enables this output when the VTEC criteria is met. These are set in the VTEC section. Both the "HS-Func Status" and "HS-Alt" switches must also be "On" for this function to work.
Idle >12Volt	%	This is the amount of additional idle duty to add when the battery voltage is less than 12 volts.
Idle Brown	Volts	Stepper motor IAC only. If the battery voltage is below the threshold, the stepper motor will stop moving and save the current position. i.e. Not enough voltage to continue. A typical value would be about 9 volts.
Idle Brown Save	On/Off	Off for PWM type IAC motors, on for Stepper type IAC motors
Idle Hi	%	How much duty change required for the Idle Hi condition. This is typically used during engine coast down. To activate, set Idle High Add and Idle Hi Time also.
Idle Hi Add	RPM	Additional rpm to add to the Target Idle RPM when in the Idle Hi condition. See Idle Hi and Idle Hi Time also.
Idle Hi Speed	MPH	When you are above this speed, the high idle condition will be maintained indefinitely. For this to work, the vehicle speed sensor (VSS) must be set up.
Idle Hi time	Sec	Once the idle conditions have been met, this counter limits how long the Idle Hi conditions will be met. See also: Idle Hi Add and Idle Hi.
Idle Jack	%	When a heavy load is anticipated (A/C), this amount of duty is added to the existing duty to maintain the existing target RPM.
Idle Max Speed	RPM	Maximum RPM threshold for the idle condition. If decel fuel cut is used, make sure this only activates after it is exited.
Idle Min Speed	RPM	This is the lowest Idle speed that can be possible but must be above cranking exit speed.
Idle Park	%	Stepper motor type IAC only. This is the position to park the IAC motor in anticipation of the next engine start. See Idle Park, Idle Park Stopped also.

Idle Park Stopped	On/Off	Stepper motor type IAC only. Setting this has the ECM reset the IAC to the Idle Park % position.
Idle PW	Hz	The Idle PW is used to set the IAC PW control frequency. Make sure the WG/Idle PW TPS value is high enough to not mess up your idle PW settings
Idle PW1 Invert	On/Off	Inverts the PW1 output. Makes 100% duty 0%, and vice versa.
Idle Pwr save	On/Off	Reduces current for really cheap (i.e. poor quality) stepper motors. The normal value is off.
Idle R/S Key on	On/Off	Stepper motor type IAC only. Setting this has the ECM reset the IAC to the Idle Park % position just after the ignition key on event.
Idle R/S Rate	mS	Stepper motor type IAC only. This is the pulse rate to drive the IAC motor during the reset function.
Idle R/S stop	On/Off	Stepper motor type IAC only. Setting this has the ECM reset the IAC to the Idle Park % position just after the ignition key is turned off. You must confirm that power is still available to the AIC motor after key off to do this. The Main Relay function was added just for this purpose.
Idle R/S TP	On/Off	This tells the idle stepper motor to re-start when above a determined throttle position. The engine must be running and out of cranking. See also: Idle R/S TP Off and On.
Idle R/S TP OFF	%	When operating under this value, the idle stepper will not reset. This should be lower than Idle R/S TP On.
Idle R/S TP On	%	When operating above this value, the idle stepper will reset. This should be higher than Idle R/S TP Off.
Idle Rate	mS	This is the frequency of update for the output drive to the IAC. For stepper motor type IAC's, it should be between 4mS & 30mS. For PW drives it should be about the same as the drive frequency set in Idle PW and Idle PW*256. Do not adjust this to change the response of the IAC circuit. For that, use the Idle Set Rate term.
Idle Set +max	%	This is the maximum additional percentage idle allowed to maintain target idle.
Idle Set Band-	RPM	This is the amount below the Idle Target to consider the idle speed to be OK, with no adjustment needed. Typical value is -25.
Idle Set Band+	RPM	This is the amount above the Idle Target to consider the idle speed to be OK, with no adjustment needed. Typical value is 25.
Idle Set Invert	On/Off	Sets the correct direction to the idle set feedback control routine.
Idle Set -min	%	This is the maximum percentage amount to take away to maintain target idle.
Idle Set Rate	mS	IAC control time base. Making this time smaller speeds decision to change the output but may make it "hunt". Increase the number to the Targets value that can still accurately control the idle.
Idle Step Clock	On/Off	invert for stepper motors (physical reversal ccw or cw)
Idle Step#1/2	On/Off	When using outputs as idle control the appropriate Idle step #'s need to be set to on. When not using them, the off position allows for user-defined control. Stepper motors only
Idle Step#3/4	On/Off	
Idle Step#5/6	On/Off	
Idle Step#7/8	On/Off	
Idle Throttle	Degrees	When under this number, the engine is considered to be in the idle condition.
Idle Throttle X	Degrees	When over this number, the engine is considered to be exiting the idle condition.

Idle X/X		This nomenclature is used to identify the Idle circuits. These are a full-bridge (or antagonistic pair). There are two wires associated with Idle circuit, which can be used as alternate functions ONLY if a stepper motor is not used for idle speed control. There are four complete circuits for this type of output, 1/2 3/4 5/6 and 7/8. In the case of only one stepper motor being used for idle control, then the four remaining pairs would be available for auxiliary use. In the case where a stepper motor were to be used for idle speed control and boost control then there would not be any remaining idle circuits for auxiliary use. There are eight pairs that are available. The LS circuits are switches activated when the criteria set in the parameters below are met. The full-bridge concept refers to the fact that there are a pair of wires for each idle output, one a HS and the other LS. In other words one would be used as a pull to ground circuit (to trigger a relay for example) and the other would output 12V to a device (such as a shift light). Only one per Idle pair can be used. On the AEM Race ECU Idle 1/2 is not available.
IdleX/X AFR	On/Off	This activates the output when the AFR exceeds either the AFR#1 min or AFR#1 max values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
IdleX/X Alt	On/Off	This turns the output circuit on or off. Off-non active, on-active. Note that when an output circuit is used for a function it becomes dedicated to that function. In other words, the same circuit cannot drive the VTEC solenoid and the shift light simultaneously. The circuits are switches activated when the criteria set in the parameters below are met.
IdleX/X AltSwt	On/Off	This allows the user to activate this output circuit via a switch input. An example of this would be for a nitrous oxide solenoid. All of the operational parameters defined in the setup must be met before the ECU becomes active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
IdleX/X Cool	deg C	The engine coolant temperature at which the output circuit is triggered to be active or not depending on the "Cool Hi" Selection.
IdleX/X Cool Hi	On/Off	This is the switch to activate or deactivate the output circuit based on the engine coolant temperature. When the switch is "OFF", then the engine coolant temperature which the circuit becomes active is below the "Cool" value. When the switch is "ON", the engine coolant temperature at which the circuit becomes active is above the "Cool" value. This is usually used to drive the radiator fans. The "Cool Hi" value must also be set to the appropriate value.
IdleX/X Fuel Pump	On/Off	When active this makes this output driver emulate the traits of a fuel pump. Both the "HS Func Status" and the "HS Alt" switches must also be "On" for this function to work.
IdleX/X Func Status	On/Off	When on, the output can be used as a specific output function. I.E. fuel pump with priming. After this is enabled, the specific function (AFR, ALTSwt, RevLimit2, SwtRtd, VTEC or Fuel Pump) must also be enabled.
IdleX/X I	Amps	Sets the idle stepper motor current. 0, 50mA, 500mA and 2 amps. (2 is normal). This MUST always be set, When idle power save mode is entered, the current here is decreased so watch out for it.
IdleX/X Load	%	The engine Load (Y-axis on the map) at which the output is triggered to be active or not depending on the Load Hi Selection.
IdleX/X Load Hi	On/Off	This defines if the output should be activated when the engine load exceeds the outputs Load value or when the engine load is below the outputs Load value. Setting the switch to "On" makes the circuit becomes active when the load is above the outputs Load threshold.

IdleX/X RevLimit2	On/Off	Setting this value to "On" will enable this output when the engine is under the control of RevLimit2 (the secondary rev limiter, activated by a switched input, commonly called a two step limit). This should not be used to enable the driver if the device is to be driven off of the normal (higher) rev limit. That is much easier to define by simply setting the outputs Speed and Speed Hi values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
IdleX/X Speed	RPM	The engine speed (X-axis on the map) at which this output circuit is triggered to be active or not depending on the Speed Hi Selection.
IdleX/X Speed Hi	On/Off	This defines if the output should be activated when the engine speed exceeds the Speed value or when the speed is below the Speed value. Setting the switch to "On" makes the circuit becomes active when the speed is above the Speed value.
IdleX/X Switch	Input Channel	Channel to be used as switch input to activate this driver
IdleX/X SwtRtd	On/Off	An external switch can be set up to use a timing map that retards the ignition timing (typically used for boost enhancement at vehicle launch). If this is in use, this can also be used as an activation criteria to drive an output. Setting this variable "On" will activate this output when the SwtRtd function is active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
IdleX/X TP	%	The throttle position (Y-axis on the map) at which the output is triggered to be active or not depending on the TP Hi Selection.
IdleX/X TP Hi	On/Off	This defines if the output should be activated when the throttle position exceeds the outputs TP value or when the throttle position is below the HS TP value. Setting the switch to "On" makes the circuit becomes active when the throttle position is above the outputs TP value.
IdleX/X VTEC	On/Off	Setting this to "On" enables this output when the VTEC criteria is met. These are set in the VTEC section. Both the "HS-Func Status" and "HS-Alt" switches must also be "On" for this function to work.
Ign +1/4 Tooth	On/Off	Cam-Crank setting. Activated on the Mitsubishi.
Ign Cut +	%	If RPM exceeds 50 rpm over the rev limit, this additional Ignition Cut Rate is added to the Ign Cut Rate.
Ign cut rate	%	This is the percentage of ignition to cut when active.
Ign Diff	On/Off	Use the 3D Ignition Difference map when the Dif SW In pin is activated. The Ignition Difference map is a "delta" map meaning the value is added to the existing ignition map.
Ign invert	On/Off	Inverts the ignition output signal. Used on some MSD's.
Ign Range	Teeth (Crank Deg)	This is how many teeth pass in 90 degrees of crank rotation.
Ign Tooth #1(10)	Teeth (Crank Deg)	The ignition tooth is the position of the fuel tooth that will fire an ignition event. It is not the physical tooth but a conceptual entity of fuel tooth position relative to crank angle. On engines that have a distributor, only Ign. Tooth #1 will be used. Cars that will use wasted spark or direct fire systems will use a number of Ign. Teeth that corresponds to the number of coils used. An example of this would be a six-cylinder engine wasted spark system that uses three coils. An example of how to set the Ign. Teeth is: On a wasted spark six cylinder engine that uses a crank trigger wheel with 24 teeth on the cam has 12 teeth pass for each revolution of the engine. The reason the number is 1/2 of the number of available teeth is that the distributor turns at 1/2 speed of the engine. This means there are 12 teeth that define three ignition events per engine revolution. Ign. Tooth #1 would define the firing point for coil #1, Ign. Tooth #2 for Coil #2 and Ign. Tooth #3 for Coil #3.
Ignition cut	RPM	This is the RPM at which to activate any ignition cut.
Ignition cut 2nd	RPM	This is the rpm at which to cut any ignition while the secondary rev limiter is active.
Ignition Sync	Teeth (Crank Deg)	Allows you to move all the ignition teeth around by this amount

Inject Tooth #1(10)	Teeth (Crank Deg)	This is the fuel tooth that the command to fire the fuel injector comes from. An example of this is, on a I-6 engine with a firing order of 1,5,3,6,2,4 and 3 teeth on the crank trigger wheel would have the Inject tooth set up as follows: Inject Tooth #1 for Cyl. #1, Inject tooth #2 for Cyl. #5, Inject Tooth #3 for Cyl #3, Inject Tooth #4 for Cyl. #6, Inject Tooth #5 for Cyl. # 2, Inject Tooth #6 for Cyl. # 4.
Injector #1(10)	On/Off	This is the control for each fuel injector. If the injector is turned off then the output for the "OFF" injectors are available for ancillary functions.
Injector Duty MX	%	This determines the maximum pulse width duty to the primary injectors when staged injection is being used. Once primary injector duty exceeds this, (typical value = 95%) the EMS automatically puts all additional fuel to the secondary injectors according to the flow scaling parameter "Secondary".
Injector min	uS	If the calculated injector pulse (not including the battery offset) is below this value, no injection is performed.
Injector Sync	Teeth (Crank Deg)	This synchronizes the injection event to the valve opening angle for best emissions and throttle response. Move this number up or down to obtain the best idle, and throttle response. For fine tuning of this use the injector angle map. Changing this value moves all of the injectors advanced or retarded in relation to TDC.
Injector#10 Spark	On/Off	Allows inj 10 output to be used as an ignition driver. Driven off of fuel tooth. Not as accurate (only 5uS accuracy, normal is 2.5uS)
Knock control	On/Off	This enables the knock control feedback option
Knock dec	%	This is the amount of fuel to be removed (every Knock Restore Rate) once knock has been removed.
Knock Fuel Max	%	This sets the maximum allowable fuel to be added under a knock condition.
Knock inc	Degrees	This is the amount of ignition timing to add back in when knock has been removed.
Knock rate	Revs	This is the number of engine revolutions at which to restore the normal running condition from a knock condition.
Knock Rich	%	This is the amount of fuel (enrichment) take add per volt of knock sensor feedback.
Knock Rtd	Degrees	This is the amount of ignition timing to take out per volt of knock sensor feedback.
Knock Rtd Max	Degrees	This sets the maximum ignition retard allowed under a knock condition.
Launch Rtd	Degrees	currently not activated
Launch Rtd+	Degrees	currently not activated
LD0MPC		Used by the ECU during map optimization
Log Always	On/Off	This sets the internal data logger to an always logging condition. So any time the key is on, the ECU information is being recorded.
Log Code 1(15)	Hex	Internal Use Only. Do not change.
Log Load		Load threshold to enable internal logging. The load must be above this load to log
Log Rate	Gain Multiplier	This number is multiplied by 4.1 milliseconds for logging rate. 4.1 milliseconds is the fastest sample rate.
Log Reset	On/Off	This allows the internal data logger to become active after using a direct pc connection for logging.
Log Speed	RPM	RPM threshold to enable internal logging. The engine speed must be above this to log
Log SW in pin	Input Channel	If Log SW is "On", this input on this channel will be monitored to start/stop internal logging.
Log Switch	On/Off	This sets the internal data logger to be active only when a user toggle switch has been activated.
Log Throttle	%	Throttle threshold to enable internal logging. The throttle position must be above this to log
Log VSS	MPH	Vehicle Speed threshold to enable internal logging. The car speed must be above this to log
Log Wrap	On/Off	This sets the internal data logger to write over itself when the memory capacity has been filled.

LS		Low Side circuit. These are all of the parameters that can be set for the 12 auxiliary low side circuits. A low side driver switches ground. You hook 12 volts up to the device directly and the other to the LS driver. The ECU grounds the LS driver when the device is to be activated. Note that when a LS circuit is used for a function it becomes dedicated to that function. In other words, the same LS circuit cannot drive the nitrous solenoid and the fuel pump simultaneously. The LS circuits are switches activated when the criteria set in the parameters below are met.
LS(1-12) AFR	On/Off	This activates the output when the AFR exceeds either the AFR#1 min or AFR#1 max values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
LS(1-12) Alt	On/Off	This turns the output circuit on or off. Off-non active, on-active. Note that when an output circuit is used for a function it becomes dedicated to that function. In other words, the same circuit cannot drive the VTEC solenoid and the shift light simultaneously. The circuits are switches activated when the criteria set in the parameters below are met.
LS(1-12) AltSwt	On/Off	This allows the user to activate this output circuit via a switch input. An example of this would be for a nitrous oxide solenoid. All of the operational parameters defined in the setup must be met before the ECU becomes active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
LS(1-12) Cool	deg C	The engine coolant temperature at which the output circuit is triggered to be active or not depending on the "Cool Hi" Selection.
LS(1-12) Cool Hi	On/Off	This is the switch to activate or deactivate the output circuit based on the engine coolant temperature. When the switch is "OFF", then the engine coolant temperature which the circuit becomes active is below the "Cool" value. When the switch is "ON", the engine coolant temperature at which the circuit becomes active is above the "Cool" value. This is usually used to drive the radiator fans. The "Cool Hi" value must also be set to the appropriate value.
LS(1-12) Fuel Pump	On/Off	When active this makes this output driver emulate the traits of a fuel pump. Both the "HS Func Status" and the "HS Alt" switches must also be "On" for this function to work.
LS(1-12) Func Status	On/Off	When on, the output can be used as a specific output function. I.E. fuel pump with priming. After this is enabled, the specific function (AFR, ALTSwt, RevLimit2, SwtRtd, VTEC or Fuel Pump) must also be enabled.
LS(1-12) Load	%	The engine Load (Y-axis on the map) at which the output is triggered to be active or not depending on the Load Hi Selection.
LS(1-12) Load Hi	On/Off	This defines if the output should be activated when the engine load exceeds the outputs Load value or when the engine load is below the outputs Load value. Setting the switch to "On" makes the circuit becomes active when the load is above the outputs Load threshold.
LS(1-12) RevLimit2	On/Off	Setting this value to "On" will enable this output when the engine is under the control of RevLimit2 (the secondary rev limiter, activated by a switched input, commonly called a two step limit). This should not be used to enable the driver if the device is to be driven off of the normal (higher) rev limit. That is much easier to define by simply setting the outputs Speed and Speed Hi values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
LS(1-12) Speed	RPM	The engine speed (X-axis on the map) at which this output circuit is triggered to be active or not depending on the Speed Hi Selection.
LS(1-12) Speed Hi	On/Off	This defines if the output should be activated when the engine speed exceeds the Speed value or when the speed is below the Speed value. Setting the switch to "On" makes the circuit becomes active when the speed is above the Speed value.
LS(1-12) Switch	Input Channel	Channel to be used as switch input to activate this driver

LS(1-12) SwtRtd	On/Off	An external switch can be set up to use a timing map that retards the ignition timing (typically used for boost enhancement at vehicle launch). If this is in use, this can also be used as an activation criteria to drive an output. Setting this variable "On" will activate this output when the SwtRtd function is active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
LS(1-12) TP	%	The throttle position (Y-axis on the map) at which the output is triggered to be active or not depending on the TP Hi Selection.
LS(1-12) TP Hi	On/Off	This defines if the output should be activated when the throttle position exceeds the outputs TP value or when the throttle position is below the HS TP value. Setting the switch to "On" makes the circuit becomes active when the throttle position is above the outputs TP value.
LS(1-12) VTEC	On/Off	Setting this to "On" enables this output when the VTEC criteria is met. These are set in the VTEC section. Both the "HS-Func Status" and "HS-Alt" switches must also be "On" for this function to work.
MAF max	Volts	This is the value of the MAF sensor signal in volts that corresponds with the highest mass airflow through the engine. The voltage value varies based upon the MAF sensor used in the system. The (100%) maximum load value displayed in AEMPro is determined by this setting. This value is not used for Karman Vortex type MAF sensors
MAF min	Volts	This is the value of the MAF sensor signal in volts that corresponds with the lowest mass airflow through the engine. The voltage value varies based upon the MAF sensor used in the system. The load value of 0% displayed in AEMPro is determined by this setting. This value is not used for Karman Vortex type MAF sensors
MAF Vortex	On/Off	This is the switch to use a vortex shedding mass airflow sensor (Karman) commonly used on Mitsubishi and some Toyota/Lexus cars. When this option is selected, the MAP option is disabled. For this to function, the MAF option must also be enabled. The MAF Vortex input needs to be connected to the T4 (TDC) input pin, a T4 edge must be selected and the proper FLOW MAX value must be set. MAF MAX and MAF MIN are ignored since this is a frequency input.
Main Relay Cut	Seconds	Time in seconds after key off that the ignition drivers will continue to pulse, keeping the engine running. i.e. turbo timer run on time.
Main Relay Out	Output Driver Channel	Channel to output the main relay function to.
Main Relay Park	Seconds	Time in seconds after key off that the IAC motor park routine begins. It assumes that the motor is OFF so this time MUST be longer than MAIN RELAY CUT
Main Relay SW in	Input Channel	Channel where the Main Relay can find the ignition switch on.
Main Relay Time	Seconds	Time in seconds after key off that the main relay will totally power down. This must be longer than MAIN RELAY CUT and MAIN RELAY PARK and enough time should be allowed to actually park the IAC which starts its parking routine only after MAIN RELAY PARK time has elapsed.
MAP kPa c	Offset	This is the offset for calibrating the Map sensor. $\text{Map kPa} = \text{Raw} * \text{Gain} + \text{Offset}$
MAP kPa m	Gain Multiplier	This is the gain for calibrating the Map sensor. $\text{Map kPa} = \text{Raw} * \text{Gain} + \text{Offset}$
MAP max	Volts	This is the value of the MAP signal in volts that corresponds with the maximum map value. This number represents high manifold pressure (full throttle on a naturally aspirated engine or boost on a forced induction engine). This number varies based upon the MAP sensor used in the system. The maximum load value displayed in AEMPro is determined by this setting.
MAP min	Volts	This is the value of the MAP signal in volts that corresponds with the minimum map value. This is the number that represents low manifold pressure (high vacuum) and will vary based upon the MAP sensor used in the system. The load value of 0 displayed in AEMPro is determined by this setting.

Mass Air Flow	On/Off	This is the switch to use a MAF sensor as the primary load input with the system. If neither this nor the MAP option is selected, the load input will default to the Throttle position sensor.
microSec/Bit	uS	This is the scaling factor for converting VE in the fuel table to the injector fuel pulse. This scaling factor can be used to rescale the fuel map to obtain more range of fuel delivery. An example of it's use would be if when setting up the fuel map, you run out of numeric values at higher fuel flow areas of the map. The scalar can be raised to allow higher numbers. The down side of doing this is that there is a small loss of resolution at the low fuel flow rates. A typical value for most applications is 75. On applications where the fuel injector is slightly too small a higher number may have to be used and the converse is true for too large an injector.
Missing	Teeth (Crank Deg)	This is the number of missing teeth on the crank angle sensor if any.
MX Divide	Divisor (integer)	Divisor used on fine crank tooth systems to reduce the EMS overhead. This needs to be a whole number and should be set so that when the number of crank teeth is divided by it, the result is between 10-16. An example would be a 36 tooth crank wheel. Setting "MX Divide" to 3 will give a synthesized tooth count of 12. Once this is done, set all tooth references to 12, not to the original 36. On missing tooth systems, use the total tooth count, not the actual tooth count. example: for a 60 minus 2 (electromotive), "MX divide" should be 5 ($60/5 = 12$, perfect!)
MX Divide Offset	Teeth (Crank Deg)	Accounts for the number of missing teeth that can't be divided out from the "MX Divide" term. Set this is follows: "MX Divide Offset" = "MX Divide" - # of actual missing teeth - 1. For a 60-2 setup with a MX divide of 5, the MX Divide Offset should be $5-2-1 = 2$
MX Sync Test	Teeth (Crank Deg)	How many teeth must pass before resetting the sync errors to 0 during cranking. Needs to be a number greater than the number of internal crank (synthesized) teeth. Must be greater than actual teeth/"MX Divide".
MX Time	%	not currently used
N2O control	On/Off	Turing this "On" makes the Nitrous Oxide control function active
N2O Fuel Map	Fuel map multiplier (%)	When nitrous is active, this 3D map is multiplied with your existing base 3D fuel map.
N2O Ign Map	Ign offset (deg)	When nitrous is active, this 3D map is added to your existing base 3D ignition map. Negative numbers in this map will result in timing being retarded.
N2O in pin	Input Channel	Sets the input channel that the nitrous control function should be watching to determine when nitrous is requested.
N2O Load Min	%	Nitrous will be activated only when the engine load is above this value.
N2O Load ON	%	Minimum engine load for nitrous to be activated. N2O In Pin and N2O Control both must be active for nitrous to activate. Also, the Throttle and RPM conditions must be met.
N2O Max Load OFF	%	Nitrous will be activated only when it is below this value. This is an over boost type function that disables the nitrous under unsafe engine conditions.
N2O out pin	Output Driver Channel	This is the channel that the nitrous function is going to control. This is where you actually hook up the nitrous solenoid.
N2O Spd OFF	RPM	Nitrous will be activated only when it is below this value. This is an overrev type function that should disable the nitrous under unsafe engine conditions or when on the rev limiter.
N2O Spd ON	RPM	Minimum engine RPM for nitrous to be activated. N2O In Pin and N2O Control both must be active for nitrous to activate. Also, the Load and TPS conditions must be met.
N2O TPS OFF	Deg	Nitrous will be deactivated only when the TPS value falls below this value (after it has been activated, of course). It should be set BELOW the N2O TPS ON.
N2O TPS ON	Deg	Minimum throttle position for nitrous to be activated. N2O In Pin and N2O Control both must be active for nitrous to activate. Also, the Load and RPM conditions must be met.

No Sync	On/Off	Force the system to run without a cam sensor. This only works with missing tooth crank triggers only with wasted spark.
No Sync cranking	On/Off	Force the system to start without a cam sensor. This only works with missing tooth crank triggers only with wasted spark.
O2 FB +Limit	%	O2 feedback maximum positive range (making it richer).
O2 FB Coolant OK	C	O2 feedback will only operate when coolant temp is above this value.
O2 FB Gain	Gain Multiplier	O2 feedback overall gain. Is equal to the lambda error (actual-target) * 2^OX_FB_Gain.
O2 FB -Limit	%	O2 feedback maximum negative range (making it leaner).
O2 FB Load	%	O2 feedback will only operate when engine load is below this value.
O2 FB Rate	mS	O2 feedback base timer for both P & I terms. A smaller number gives a faster response by effectively increasing the gain.
O2 FB Speed	RPM	O2 feedback will only operate when engine RPM is below this speed and not in cranking mode.
O2#1 Gain	Gain Multiplier	Sets the input gain for the #1 O2 sensor. Scales the AFR1 raw voltage to read the same as the measured voltage input.
O2#2 Gain	Gain Multiplier	Sets the input gain for the #2 O2 sensor. Scales the AFR2 raw voltage to read the same as the measured voltage input.
O2FB control	On/Off	O2 feedback on/off
Pickup comp	uS	This value is an offset between when the ECU receives the input signal processes it and the coil reacts to the output to deliver the spark to the appropriate spark plug. Typically as the engine speed increases there is less time to perform the calculation to output the signal to the coil. The way this is setup is to check the ignition timing at idle and then at elevated RPM. If at idle the timing is correct (agrees with the computer screen) and when at elevated RPM the timing reads higher on the screen than the timing light indicates then the pickup comp has to be raised to advance the timing at higher RPM.
Purge Duty max	mS	Maximum duty cycle for Purge Canister PWM valve (25 mS is typical)
Purge Duty min	mS	Minimum duty cycle for Purge Canister PWM valve (5 mS is typical)
Purge inc/dec	mS	Purge Canister. The valve pulse width starts at "Purge Duty Min" and then increases by this amount, every 64 mS until "Purge Duty Max" is achieved. It stays at this duty as long as the "Purge Valve TPS" throttle condition is met. (4 mS is Typical)
Purge Period	mS	Base PWM period for Purge Canister solenoid valve (50 mS is typical)
Purge PWM Valve	Output Driver Channel	Channel that the Purge Canister valve should output to. This is the charcoal can between the fuel tank and the intake.
Purge TPS	%	Activate the Purge Canister above this throttle position.
Purge Valve#1	Output Driver Channel	Activates this output when the Purge Canister is on. Only necessary if the configuration has a simple on/off valve between the purge solenoid and the intake.
Purge Valve#2	Output Driver Channel	Activates this output when the Purge Canister is on. Only necessary if the configuration has a simple on/off valve between the purge solenoid and the intake.
PW(1-2) AFR	On/Off	This activates the output when the AFR exceeds either the AFR#1 min or AFR#1 max values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
PW(1-2) Alt	On/Off	This turns the output circuit on or off. Off-non active, on-active. Note that when an output circuit is used for a function it becomes dedicated to that function. In other words, the same circuit cannot drive the VTEC solenoid and the shift light simultaneously. The circuits are switches activated when the criteria set in the parameters below are met.

PW(1-2) AltSwt	On/Off	This allows the user to activate this output circuit via a switch input. An example of this would be for a nitrous oxide solenoid. All of the operational parameters defined in the setup must be met before the ECU becomes active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
PW(1-2) Cool	deg C	The engine coolant temperature at which the output circuit is triggered to be active or not depending on the "Cool Hi" Selection.
PW(1-2) Cool Hi	On/Off	This is the switch to activate or deactivate the output circuit based on the engine coolant temperature. When the switch is "OFF", then the engine coolant temperature which the circuit becomes active is below the "Cool" value. When the switch is "ON", the engine coolant temperature at which the circuit becomes active is above the "Cool" value. This is usually used to drive the radiator fans. The "Cool Hi" value must also be set to the appropriate value.
PW(1-2) Fuel Pump	On/Off	When active this makes this output driver emulate the traits of a fuel pump. Both the "HS Func Status" and the "HS Alt" switches must also be "On" for this function to work.
PW(1-2) Func Status	On/Off	When on, the output can be used as a specific output function. I.E. fuel pump with priming. After this is enabled, the specific function (AFR, ALTSwt, RevLimit2, SwtRtd, VTEC or Fuel Pump) must also be enabled.
PW(1-2) Load	%	The engine Load (Y-axis on the map) at which the output is triggered to be active or not depending on the Load Hi Selection.
PW(1-2) Load Hi	On/Off	This defines if the output should be activated when the engine load exceeds the outputs Load value or when the engine load is below the outputs Load value. Setting the switch to "On" makes the circuit becomes active when the load is above the outputs Load threshold.
PW(1-2) RevLimit2	On/Off	Setting this value to "On" will enable this output when the engine is under the control of RevLimit2 (the secondary rev limiter, activated by a switched input, commonly called a two step limit). This should not be used to enable the driver if the device is to be driven off of the normal (higher) rev limit. That is much easier to define by simply setting the outputs Speed and Speed Hi values. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
PW(1-2) Speed	RPM	The engine speed (X-axis on the map) at which this output circuit is triggered to be active or not depending on the Speed Hi Selection.
PW(1-2) Speed Hi	On/Off	This defines if the output should be activated when the engine speed exceeds the Speed value or when the speed is below the Speed value. Setting the switch to "On" makes the circuit becomes active when the speed is above the Speed value.
PW(1-2) Switch	Input Channel	Channel to be used as switch input to activate this driver
PW(1-2) SwtRtd	On/Off	An external switch can be set up to use a timing map that retards the ignition timing (typically used for boost enhancement at vehicle launch). If this is in use, this can also be used as an activation criteria to drive an output. Setting this variable "On" will activate this output when the SwtRtd function is active. Both the "HS Func Status" and "HS Alt" switches must also be "On" for this function to work.
PW(1-2) TP	%	The throttle position (Y-axis on the map) at which the output is triggered to be active or not depending on the TP Hi Selection.
PW(1-2) TP Hi	On/Off	This defines if the output should be activated when the throttle position exceeds the outputs TP value or when the throttle position is below the HS TP value. Setting the switch to "On" makes the circuit becomes active when the throttle position is above the outputs TP value.
PW(1-2) VTEC	On/Off	Setting this to "On" enables this output when the VTEC criteria is met. These are set in the VTEC section. Both the "HS-Func Status" and "HS-Alt" switches must also be "On" for this function to work.

Rev Light Out	Output Driver Channel	Output channel for the gear dependant rev light. This can be set in the "Rev Light Gear Table" and is only useful if you have defined a gear in, which is usually A/T's only. Everyone else should simply use a LS output with an RPM trigger and ignore this function.
Rev Limit in pin	Input Channel	Channel Input that your secondary (2 step) rev limiter switch is input on.
Reverse Gear		Which gear in the gear table is the reverse gear.
RevLimit2 VSS	MPH	Speed threshold that you must be below for the RevLimit2 (2 step) function to activate.
Road Speed M	Gain Multiplier	This is the fine adjust for the internal vehicle speed channel. Increasing this number makes the calculated vehicle speed increase. If this cannot go high enough, setting VSS*8 to "On" gives more range.
Road Speed Min	MPH	Minimum vehicle speed before a speed of 0 is assumed and displayed.
S Swt Analog in	Input Channel	Shift switch analog input channel. It appears on switches#2 when all active. Once all conditions have been met, it activates an internal channel (#10) that is broadcast in the EMS and can be used as a channel in for some sort of shift cut function.
S Swt High	Volts	Voltage threshold above which the Shift Cut function may be active.
S Swt Low	Volts	Voltage threshold at which the shift switch is determined to be off. Should be set lower than "S Swt High".
S Swt Speed	RPM	Speed threshold that you must be above before the Shift Cut function may be on.
S Swt TP	%	Throttle threshold that you must be above before the Shift Cut function may be on.
Secondary	%	Multiplier for staged injection. This tells the ECM the flow rate difference between the secondary injectors versus the primary injectors. If you have the same number & same size of secondary injectors as your primaries, this value is 100%. If you have secondary injectors that flow 3X the primaries, the value is 33%. If you have 4x secondaries, but only 2 (on a 4 cyl), the value should be 50%. Remember to account for the total primary flow rate (flow * # inj) and the total secondary flow rate (flow * # inj). This value must always be 100% or less. i.e. your secondaries must flow as much or more than the primaries.
Spark Diff	On/Off	Activates the ignition diff map. When this is on and the diff sw is satisfied, then ign diff is calculated and added to the main spark to create the trail spark.
Spark Teeth	Teeth (Crank Deg)	<p>This is the number of fuel teeth that occur per ignition cycle. In a wasted spark system every engine revolution is considered an ignition cycle. In a direct fire system the engine cycle is equal to the ignition cycle. So for example in a wasted spark system on a six cylinder engine with a 12 tooth wheel on the crankshaft. A complete engine cycle would consist of 24 pulses from this sensor. Use the following equations to calculate the spark tooth number to be entered in the option setting. If the trigger wheel being used has a tooth missing be sure to count it in the equation. An example of this is a 36-1 wheel has only 35 physical teeth but it is counted as a 36 tooth wheel. Also the distinction between the crank and cam mounted wheel is important.</p> <p>Distributed Spark Systems Sensor mounted to the crank: $(\text{teeth on crank trigger} * 2) / \text{number of cylinders}$ Sensor mounted to the cam $\text{Number of teeth on cam wheel} / \text{number of cylinders}$</p> <p>Wasted Spark Systems Sensor mounted to the crank: Use the number of teeth in the crank trigger wheel</p>

		<p>Sensor mounted to the cam Number of teeth on the cam trigger wheel/2</p> <p>Direct Fire Systems Sensor mounted to the crank: Number of teeth on crank wheel * 2 Sensor mounted to the cam Use the number of teeth on the cam trigger wheel</p>
Speed Density	On/Off	This is the switch to use a MAP sensor as the primary load input with the system. If neither this nor the MAF option is selected, the load input will default to the Throttle position sensor.
Speed T3 Filter	On/Off	Used to smooth the speed sensor, use as first defense
Speed T3 Smooth	On/Off	Used to smooth the speed sensor, very aggressive, use last.
Speed Table 100	On/Off	Sets the LSB of the RPM to be 100. This gives less available resolution for the engine speed but allows the engine speed to be mappable up from 12,300 to 25,600 rpm.
Step#2 +error	%	Used with the RX7 OMP
Step#2 +error Drv	%	Used with the RX7 OMP
Step#2 5% limit	On/Off	Sets the 5% fail status flag. If this is active and if the "Step#2 Analog In" value is within 5% of full scale (either high or low) then it must have failed. If this is true, set the motor to the position entered in "Step#2 Default"
Step#2 Brake Out	On/Off	Used with the RX7 OMP
Step#2 Clock	On/Off	Reverses the direction of the stepper motor
Step#2 Current	On/Off	Used with the RX7 OMP
Step#2 DC Pair	On/Off	Used with the RX7 OMP
Step#2 Default	%	If the "Step#2 5% Limit" flag is set and the "Step#2 Analog In" is within 5% of full scale, then the system assumes the position sensor has failed and puts the motor to this position and leaves it.
Step#2 Demand in	Output Driver Channel	This is the input channel for stepper #2.
Step#2 -error	%	Used with the RX7 OMP
Step#2 -error Drv	%	Used with the RX7 OMP
Step#2 FB +Limit	%	Used with the RX7 OMP
Step#2 FB int	Gain Multiplier	Used with the RX7 OMP
Step#2 FB -Limit	%	Used with the RX7 OMP
Step#2 FB pro	Gain Multiplier	Used with the RX7 OMP
Step#2 FB Rate	mS	Used with the RX7 OMP
Step#2 FB/2	On/Off	Used with the RX7 OMP
Step#2 PWM#1	On/Off	Used with the RX7 OMP
Step#2 swap Step#1	On/Off	Step#1 is normally used for the idle air control (IAC) motor. Step#2 is normally oil feed for the rotary motors (RX7). Setting this to "On" swaps Step#1 & Step#2.
Step#2 Throttle	On/Off	Used with the RX7 OMP
SwtRtd Adv	Deg	Advances the timing by this amount every 4.1 ms until the nominal timing is restored after the 'SwtRtd function is turned off. The timing amount is returned to normal in steps, not all at once. A larger number here returns the timing to the normal faster. Typical value is 1 degree.
SwtRtd in pin	Input Channel	Channel Input that your Timing Retard/Shift Cut function is input on.
SwtRtd Max	Deg	Total amount if Ignition retard desired while on the SwtRtd function.
SwtRtd ReArm	mS	Time to wait after Timing Retard/Ig Cut is fully restored before allowing another SWRTD function to be recognized. Acts as a switch debounce. Typical value is 500 mS.

SwtRtd Rtd	Deg	Retards the timing by this amount every 4.1 ms until the total retard amount specified in "SwtRtd Max" is achieved. The timing amount is retarded in steps, not all at once. A larger number here retards the timing faster. Typical value is 1 degree.
SwtRtd Spark Cut	On/Off	Activates the shift cut feature during SwtRtd. The ignition cut works with the ignition retard and only cuts the ignition after the full retard is achieved. After the SwtRtd function is deactivated by the switch, the timing is then advanced back to normal according to "SwtRtd Adv" and is re-armed after the time in "SwtRtdReArm" has elapsed.
SwtRtd Time	mS	Max switch on time before it is assumed to be a failed switch input and kills the function.
Sync err R/S		# of sync errors before it resets to 0. Set to 5 on Hondas, don't care on the others.
Sync Teeth	Teeth (Crank Deg)	This is the number of crank teeth that must pass before the ECU recognizes the engine position (cam angle) signal. It is a way of checking that the sensors are synchronized and the input signal is recognized properly. On an engine that has a 24 tooth crank wheel there must be 24 pulses on the crank angle sensor before the cam signal is received. must be greater than 0.
T1 Fall	On/Off	Designates the falling edge of the crank trigger signal to be a significant event. I.e. the ECU will see this as a crank trigger signal. Generally used for VR or magnetic type sensors or logic level sensors.
T1 Rise	On/Off	Designates the rising edge of the crank trigger signal to be a significant event. i.e. the ECU will see this as a crank trigger signal. Generally used for logic level sensors.
T1 swap T2	On/Off	Normally, T1 is assumed to be crank and T2 is assumed to be 1/2 speed (cam). Setting this to "On" will tell the ECU that this is not true and that Cam is T1 and Crank is T2.
T1 SWT Off	RPM	High channel sensitivity when below this value. Should be set below the on value (hysteresis). Logic level sensors (hall effect) set to 0
T1 SWT On	RPM	Low channel sensitivity above this value. Logic level sensors (hall effect) set to 0.
T2 Fall	On/Off	Designates the falling edge of the cam trigger signal to be a significant event. i.e. the ECU will see this as a sync (1/2 speed, cam) signal. Generally used for VR or magnetic type sensors or logic level sensors.
T2 Rise	On/Off	Designates the rising edge of the cam trigger signal to be a significant event. I.e. the ECU will see this as a valid sync (cam or 1/2 speed) trigger signal. Generally used for logic level sensors.
T2 SWT Off	RPM	High channel sensitivity when below this value. Should be set below the on value (hysteresis). Logic level sensors (hall effect) set to 0
T2 SWT On	RPM	Low channel sensitivity above this value. Logic level sensors (hall effect) set to 0.
T3 Fall	On/Off	Designates the falling edge of the T3 (assumed to be vehicle speed) trigger signal to be a significant event. i.e. the ECU will see this as a valid VSS signal. Generally used for VR or magnetic type sensors or logic level sensors.
T3 Rise	On/Off	Designates the rising edge of the T3 trigger signal to be a significant event. I.e. the ECU will see this as a T3 trigger signal. Generally used for logic level sensors.
T3 SWT Off	RPM	High channel sensitivity when below this value. Should be set below the on value (hysteresis). Logic level sensors (hall effect) set to 0
T3 SWT On	RPM	Low channel sensitivity above this value. Logic level sensors (hall effect) set to 0.
T4 Fall	On/Off	Designates the falling edge of the T4 (usually used for Karman type MAF sensors) trigger signal to be a significant event. i.e. the ECU will see this as a valid input signal. Generally used for VR or magnetic type sensors or logic level sensors.
T4 Rise	On/Off	Designates the rising edge of the T4 trigger signal to be a significant event. I.e. the ECU will see this as a T4 trigger signal. Generally used for logic level sensors.
T4 SWT Off	RPM	High channel sensitivity when below this value. Should be set below the on value (hysteresis). Logic level sensors (hall effect) set to 0
T4 SWT On	RPM	Low channel sensitivity above this value. Logic level sensors (hall effect) set to 0.

Tacho	Teeth (Crank Deg)	How many synthesized teeth (real crank teeth divided by "MX Divide") before changing the state of the tacho output. example: if you had 12 synthesized teeth, and wanted 2 output pulses per rev, set to 3. Since it will turn on after 3, turn off after 3 more, on after 3 more and off after 3 more for a total of 2 complete (on and off) pulses).
Tacho Pin	XPORTG Bit Mask	The Tacho Pin is a special case for outputs. It is a bit mask applied to the XPORTG channel. XPORTG channel is 8 bits representing the following outputs, in order: LS3,LS12,LS11,LS10,LS9,LS8,LS7,LS4 The tacho pin can be any one of these channels and is entered as the decimal equivalent of this binary value. For example: For the tacho to be output on LS3, set to 128 For the tacho to be output on LS12, set to 64 For the tacho to be output on LS11, set to 32 For the tacho to be output on LS10, set to 16 For the tacho to be output on LS9, set to 8 For the tacho to be output on LS8, set to 4 For the tacho to be output on LS7, set to 2 For the tacho to be output on LS4, set to 1 For it to be output on multiple pins, add the values together. Example: for the tacho to be output on LS8 and LS12, set to 68 (4+64).
TP AZ c	Volts	TP autozero. How much of a change allow the AZ to work in.
TP AZ m		How fast to move the AZ
TPS filter	%	Used for accel/decel. Filters the TPS input and the effect can be viewed in TPS filtered. It reduces the fault triggering for very sensitive throttle changes. Big number smoothes more but increases accel/decel sensitivity. 30% is normal
TPS max	Volts	The Throttle Position Sensor outputs an increasing voltage as it is opened. The ECU ranges this into a 0-100% setting. The TPS Max value is the voltage that corresponds to 100% throttle.
TPS min	Volts	The Throttle Position Sensor outputs an increasing voltage as it is opened. The ECU ranges this into a 0-100% setting. The TPS Min value is the voltage that corresponds to 0% throttle.
User#1 Analog in	Input Channel	Defines the channel to be used as the source channel for the User#1 function. This is used to send a PWM signal to an output. The duty cycle will be proportional to the signal that is set here. Used for driving dash gauges or anything else that needs a pulse width output.
User#1 period	mS	Adjusts the period of the User#1 output.
User#1 PWM out	Output Driver Channel	Sets where to send the User#1 output to.
User#2 Analog in	Input Channel	Channel of the input for the USER #2 fuel trim table
VSS * 8	On/Off	This is the coarse adjust for the internal vehicle speed channel. Setting this to "On" increases the range of the "Road Speed In" setting.
VSS Spd in	Input Channel	Channel of the input for the Vehicle Speed Sensor.
VTEC Fuel	%	This is the amount to change the fuel map while the VTEC function is active. This amount is added to the fuel map.
VTEC Load OFF	%	VTEC Function turn off threshold. If the engine load falls below this value, the VTEC function will turn off. Normally, this is set about 5% less than "VTEC Load ON".
VTEC Load ON	%	VTEC Function minimum load threshold. The engine load must be above this value for the VTEC function to become possible. The throttle and engine speed thresholds must also be met for VTEC to be active.
VTEC Spark	Deg	This is the amount to change the ignition timing while the VTEC function is active. This amount is added to the ignition map.

VTEC Spd OFF	RPM	VTEC Function turn off threshold. If the engine speed falls below this value, the VTEC function will turn off. Normally, this is set about 200 rpm less than "VTEC Spd ON".
VTEC Spd ON	RPM	VTEC Function minimum RPM threshold. The engine speed must be above this value for the VTEC function to become possible. The throttle and load thresholds must also be met for VTEC to be active.
VTEC TPS OFF	Deg	VTEC Function turn off threshold. If the throttle position falls below this value, the VTEC function will turn off. Normally, this is set about 5% - 10% less than "VTEC TPS ON".
VTEC TPS ON	Deg	VTEC Function minimum throttle threshold. The throttle position must be above this value for the VTEC function to become possible. The engine speed and load thresholds must also be met for VTEC to be active.
Waste gate	On/Off	This turns Wastegate output on. Once on, it operates from the duty tables without feedback unless "WG Feedback" is on also.
WG Duty max	%	WG feedback maximum positive range.
WG Duty min	%	WG feedback maximum negative range.
WG Error Control	On/Off	Activates the Wastegate error function
WG FB +Limit	%	Sets the maximum feedback correction allowed in the positive duty direction.
WG FB int	Gain Multiplier	Integral gain for the boost feedback algorithm (linear)
WG FB -Limit	%	Sets the maximum feedback correction allowed in the negative duty direction.
WG FB pro	Gain Multiplier	Proportional gain for the boost feedback algorithm (linear)
WG feedback	On/Off	This turns Wastegate feedback output on. Once on, the "Boost Error Table" becomes active and the WG Duty is modified based on the actual boost and the target boost.
WG P+I control	On/Off	Setting this to "On" enables the Proportional and Integral feedback control logic on the boost control. When this is "Off", only the boost error table is used to control the boost level.
WG PW	Hz	The WG PW is used to set the boost control solenoid control frequency.
WG PW2 Invert		Inverts the PW2 signal. Makes 0% duty 100% and vice-versa.
WG/Idle PW TPS	%	The idle control and boost control functions share the same frequency generator. This is not a problem since you will never be in a position where you are controlling boost during idle. This throttle threshold is the switch point between these 2 uses. Above this throttle is boost control, below is idle control. If you are not using boost control, set this to 100% and forget about it.
Wheel Teeth	Teeth (Crank Deg)	# of crank trigger wheel teeth. Total number of teeth, including missing teeth (example: 60-2 = 60)
Wide Open TP Off	%	When the TPS reading falls below this value, the engine is considered to be leaving WOT mode. Usually set below "Wide Open TP On". Used only for automatic transmission control.
Wide Open TP On	%	When the TPS reading is above this value, the engine is considered to be in WOT mode. Used only for automatic transmission control.