Calc.VE Tuning

Tutorial

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First published
March 1, 2010

Revised

March 28, 2010

Disclaimer:

Before you begin, understand this tutorial has been provided for informational purposes only. In other words, use at your own risk.

Credits:

Special thanks to joecar, mr.prick, 5.7ute, TAQuickness (tutorials), and to all other persons who provided feedback.

Introduction

This tutorial describes modifying the Mass Airflow and Volumetric Efficiency (VE) tables utilizing a MAF-Enabled Closed-Loop calibration. The test vehicle for this tutorial was a 4th Generation 2002 LS1 M6 Camaro with moderate top-end and bolt-on modifications.

Please read the entire contents of this tutorial before performing any of the steps.

Before you begin:

1. The content of this tutorial is specific to 2002 Gen-III LSx PCM's. While the concepts of this tutorial are applicable to a wide variety of GM PCM's, the calibration references to non-2002 Gen III LSx PCM platforms may not be accurate.

2. Upgrading to the latest release of the EFILive software will ensure all features are available and appear as documented.

   Upgrades may be downloaded, free of charge, from here (go to the Downloads page): http://www.efilive.com

3. Ensure you have access to a wide band O2 sensor compatible with EFILive/FlashScan. This sensor must be installed, calibrated, and in proper working order. The wide band O2 sensor is used to verify that any changes are producing correct results. Additional information regarding the use of wide band O2 sensors with EFILive can be found at http://www.efilive.com

4. If you are running fuel injectors with flow ratings other than stock, all tables related to the fuel mass model must be calibrated to match your injectors. Failure to calibrate fuel mass tables will result in erroneous data.

5. More information regarding this tutorial and its methods may be found on the forum in this thread: http://forum.efilive.com/showthread.php?t=13152

Create Calculated PIDs

Add the following Calculated PIDS to the **calc_pids.txt** file:

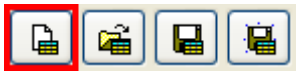
- CALC.LTFT
- CALC.LTFTBEN
- CALC.VE_Table

Hint, Additional information about use and creation of calculated PID's can be found in the EFILive Scan Tool help manual.

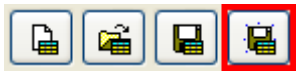
```
#Units     Low        High         Fmt        Expression
#-------   --------   --------     --------   ------------------------------------------------------------

*CLC-00-001
%           -25.0       25.0      .2          "({SAE.LONGFT1}+{SAE.LONGFT2})/2"

*CLC-00-002
factor        0.5        1.5      .4          "({SAE.LONGFT1}+{SAE.LONGFT2})/200+1"

*CLC-00-003
%             0.0      100.0      .2          "{SAE.MAF.gps}*({GM.DYNAIRTMP_DMA.C}+273.15)*3445.2
                                               /(displacement()*{SAE.RPM}*{SAE.MAP.kPa})*{CALC.LTFTBEN}"
VE            0.0        3.0      .4          "{SAE.MAF.gps}*({GM.DYNAIRTMP_DMA.C}+273.15)*15
                                               /({SAE.RPM}*{SAE.MAP.kPa})*{CALC.LTFTBEN}"

# ============================================================================
*PRN - Parameter Reference Numbers
# -------------------------------
# See sae_generic.txt for more information on the *PRN section
#
#Code                       PRN      SLOT              Units          System             Description
#--------------------------  -------  ----------------  -------------  -----------------  ----------------------------------
CALC.LTFT                   F001     CLC-00-001        %              Tuning             "LTFT Average"

CALC.LTFTBEN                F002     CLC-00-002        factor         Tuning             "LTFT BEN"

CALC.VE_Table               F003     CLC-00-003        %              Tuning             "CALC VE Table"
```

Note: In the above referenced "CLC-00-003", the displacement() function may need to be substituted with the actual engine displacement in Liters (i.e. 5.669).

Select PIDs for Calc.VE

1. Start the EFILive Scan Tool Software.
2. Press F8 or click the [PIDs (F8)] tab page.
3. Clear the PID selection by clicking on the “Clear existing PID selection” button

4. Select the following PIDs for Calc.VE tuning:
To help locate the PIDs more easily, select the ***system*** from the drop down list, and then select the PID.

System	Parameter	Name
Air	SAE.MAF	Air Flow Rate from Mass Air Flow Sensor
	SAE.MAP	Intake Manifold Absolute Pressure
	GM.MAFFREQ	Mass Air Flow Raw Frequency
Conditions	GM.CYLAIR.DMA	Air Flow Grams/Cyl
	GM.DYNCYLAIR.DMA	Air Flow Grams/Cyl – Speed Density
	SAE.RPM	Engine RPM
	SAE.VSS	Vehicle Speed Sensor
Fuel	GM.AFR	Commanded Air Fuel Ratio
	SAE.LONGFT1	Long Term Fuel Trim – Bank 1
	SAE.LONGFT2	Long Term Fuel Trim – Bank 2
	CALC.LTFT	LTFT Average
	CALC.LTFTBEN	LTFT BEN
Performance	CALC.VE_Table	Calculated Volumetric Efficiency
Spark	SAE.SPARKADV	Ignition Timing Advance for #1 Cylinder
	GM.KR	Retard Due to Knock
Temperature	SAE.ECT	Engine Coolant Temperature
	SAE.IAT	Intake Air Temperature
Throttle	SAE.TP	Absolute Throttle Position
Tune	GM.DYNAIRTMP_DMA	GM Dynamic Air TMP (Charge Temperature)
WO2-Special	EXT.WO2AFR1	External Wideband AFR

5. Save the PID file as ***My Documents\EFILive\V7\Calc.VE.pid*** by clicking on the “Save PID selection file with a new name” button.


The final PID selection should look like this:

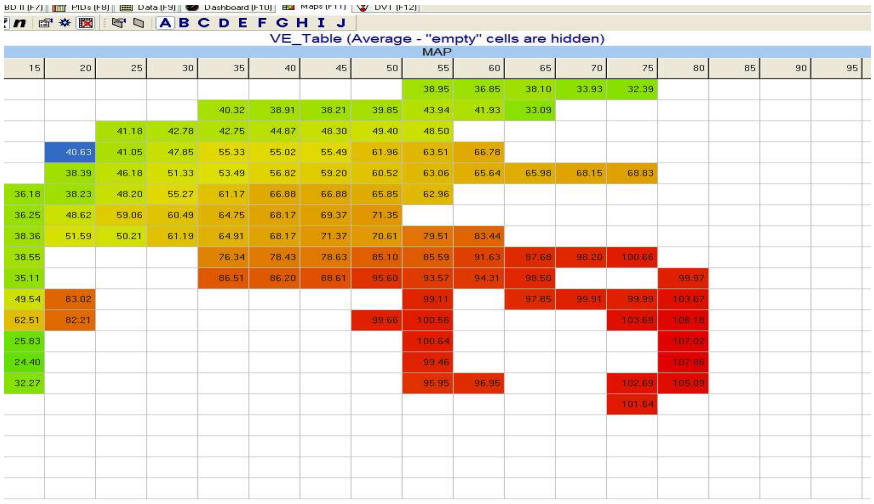
	DYNCYLAIR_DMA	Grams/cyl	-	Tune	2	GM.DYNCYLAI...
	MAF	Grams/s,Lb...	Metric	Air	2	SAE.MAF
...	BEN1	factor	-	WO2-Analog	0	CALC.BEN1
	VE_Table	%	-	Performance	0	CALC.VE_Table
	AFR	:1	-	Fuel	2	GM.AFR
	DYNAIRTMP_DMA	°C,°F	Metric	Tune	2	GM.DYNAIRTM...
	ECT	°C,°F	Imperial	Temperature	1	SAE.ECT
	RPM	RPM	-	Conditions	2	SAE.RPM
	WO2AFR1	AFR	-	WO2-Serial	2	EXT.WO2AFR1
	SPARKADV	Degrees	-	Spark	1	SAE.SPARKADV
	IAT	°C,°F	Metric	Temperature	1	SAE.IAT
	MAP	kPa,PSI	Metric	Air	1	SAE.MAP
	LONGFT1	%	-	Fuel	1	SAE.LONGFT1
	LONGFT2	%	-	Fuel	1	SAE.LONGFT2
	LTFT	%	-	Fuel	0	CALC.LTFT
	LTFTBEN	factor	-	Fuel	0	CALC.LTFTBEN
	MAFFREQ	Hz	-	Air	2	GM.MAFFREQ
	KR	Degrees	-	Spark	1	GM.KR
	VSS	KMH,MPH	Imperial	Conditions	1	SAE.VSS
	CYLAIR	Grams/cyl	-	Air	0	CALC.CYLAIR
	DAMPVSS	KMH,MPH	Imperial	Performance	0	CALC.DAMPVSS
	DIFF_DMA	:1	-	Calibrations	2	GM.DIFF_DMA
	FANTYPE_DMA		-	Calibrations	1	GM.FANTYPE_...
	ENGSIZE_DMA		-	Calibrations	1	GM.ENGSIZE_...
	ESCFAIL_DMA	Counts	-	Tests	1	GM.ESCFAIL_D...
	EST_ACB_DMA	Degrees	-	Spark	2	GM.EST_ACB_...
	EST_BASE_DMA	Degrees	-	Spark	2	GM.EST_BASE...
..	EST_BTM_DMA	Degrees	-	Spark	2	GM.EST_BTM_...
	EST_KRB_DMA	Degrees	-	Spark	2	GM.EST_KRB_...
	EST_CAT_DMA	Degrees	-	Spark	2	GM.EST_CAT_...

The above PID's are the *minimum* for Calc.VE tuning. You may add additional PIDs if required. Do not exceed 24 selected channels.

Create CALC.VE_Table {B0101} Map

1. Start the EFILive Scan Tool Software (if it is not already started).
2. Press F11 or click the [Maps (F11)] tab page.
3. Select map [A] or the first available map (from A to J).
4. Press Ctrl+Enter to open the Map property editor window.
5. Select the [Data] tab page and check the “Selected” and “Names” check boxes.
6. Select "CALC.VE_Table" from the Parameter drop down list box. Select the CALC.VE_Table that has the same units as your B0101 table (i.e. either “%” or “g*K/kPa”).
7. Select the [Column] tab page and check the “Selected” and “Names” check boxes.
8. Select "Intake Manifold Absolute Pressure (kPa)" from the Parameter drop down list box.
9. Start the EFILive Tuning Tool Software (If it is not already started)
10. Open calibration {B0101} “Main VE Table”.

    Select all cells by clicking in the extreme top-left, grey cell.
    Right click on any cell and select ***Copy with labels (Shift+Ctrl+C)***
11. Return to the EFILive Scan Tool and press the ***“Paste Labels***” button. The following labels should appear in the Col labels text field:
    `,15,20,25,30,35,40,45,50,55,60,65,70,75,80,85,90,95,100,105`
    Note the leading comma – it must be included.
12. Select the [Row] tab page and check the“Selected” and “Names” check boxes.
13. Select " Engine RPM (RPM)" from the Parameter drop down list box.
14. Press the ***“Paste Labels***” button. The following labels should appear in the Row labels text field:
    `,400,800,1200,1600,2000,2400,2800,3200,3600,4000,4400,4800,5200,5600,6000,6400,6800,7200,7600,8000`
    Note the leading comma – it must be included.
15. Click the Save as button and save the map as:
    My Documents\EFILive\V7\Maps\Calc.VE_Table.map



Sample CALC.VE_Table map.

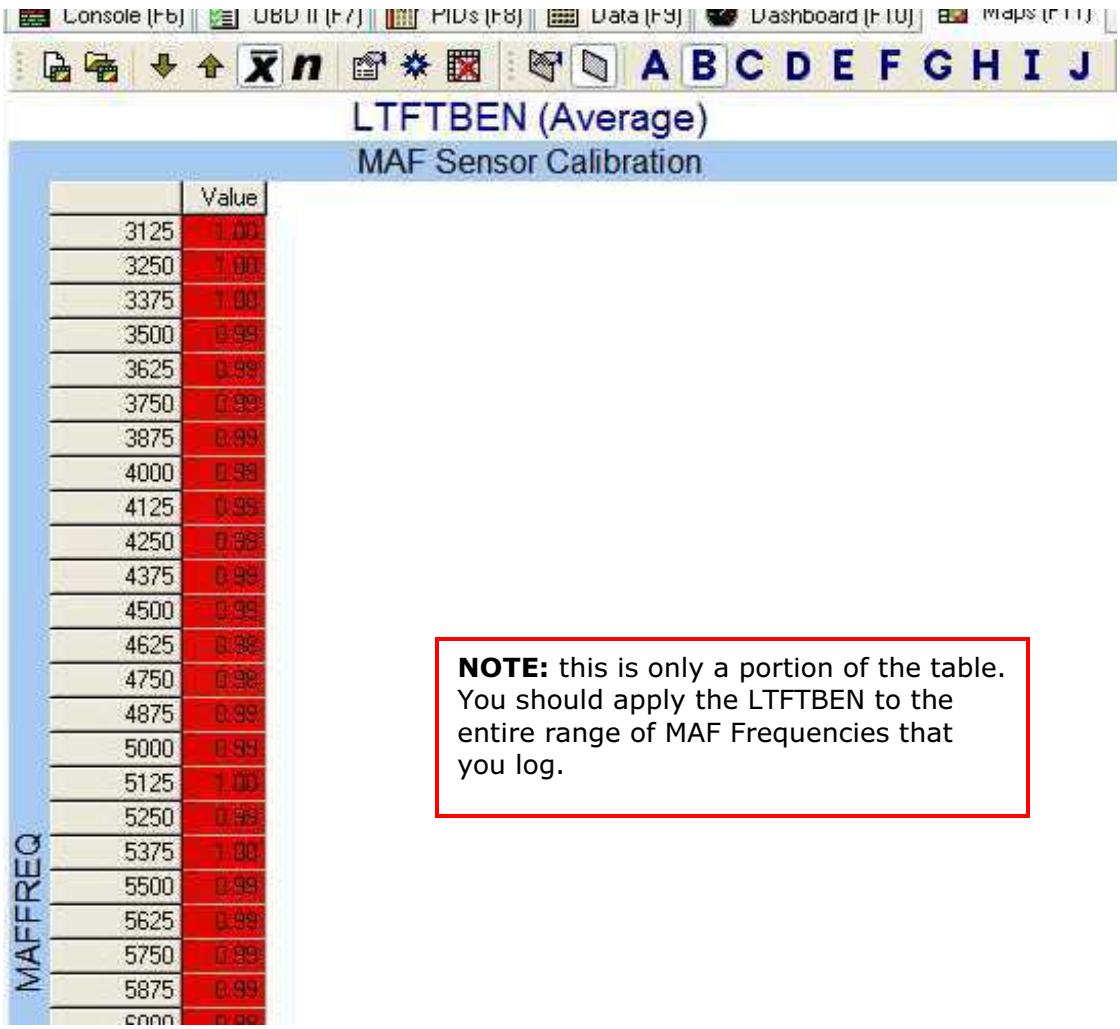
Create CALC.LTFTBEN {B5001} Map

1. Start the EFILive Scan Tool Software (if it is not already started).
2. Press F11 or click the [Maps (F11)] tab page.
3. Select map [B] or the first available map (from A to J).
4. Press Ctrl+Enter to open the Map property editor window.
5. Select the [Data] tab page and check the “Selected” and “Names” check boxes.
6. Select "Calc.LTFTBEN" from the Parameter drop down list box.
7. Select the [Column] tab page and check the “Selected” and “Names” check boxes.
8. Select "Engine RPM (RPM)" from the Parameter drop down list box.
9. Start the EFILive Tuning Tool Software (If it is not already started)
10. Type the following label into the Col labels text field:
    `,Value`
    Note the leading comma – it must be included.
11. Select the [Row] tab page and check the “Selected” and “Names” check boxes check box.
12. Select "Mass Air Flow Raw Frequency (Hz)" from the Parameter drop down list box.
13. Open calibration {B5001} “MAF Sensor Calibration”.

    Select all cells by clicking in the extreme top-left, grey cell.
    Right click on any cell and select ***Copy with labels (Shift+Ctrl+C)***

14. Press the ***"Paste Labels***" button. The row labels from {B5001} should now appear in the Row labels text field.
    Note the leading comma – it must be included.

15. Click the Save as button and save the map as:
    My Documents\EFILive\V7\Maps\Calc.LTFTBEN.map



NOTE: this is only a portion of the table. You should apply the LTFTBEN to the entire range of MAF Frequencies that you log.

Sample CALC.LTFTBEN map

Data Logging

1. Start the engine and let it come up to full operating temperature.
2. While the engine is warming up, start the EFILive Scan Tool software, connect to the vehicle and start monitoring your data (do not log at this time).

> To start monitoring data, click the yellow button.
> To start logging data, click the red button.
> Once logging or monitoring has started, you can toggle between logging and monitoring by pressing Ctrl+space bar.

3. Once the engine has reached normal operating temperature, usually 76°C (168°F) or higher, begin your drive and start data logging.

> Having a passenger monitor your data maps can be helpful.
>
> Driving technique is the key; keep conditions such as RPM, throttle position, and temperatures as steady as possible while trying to hit as many cells as possible.

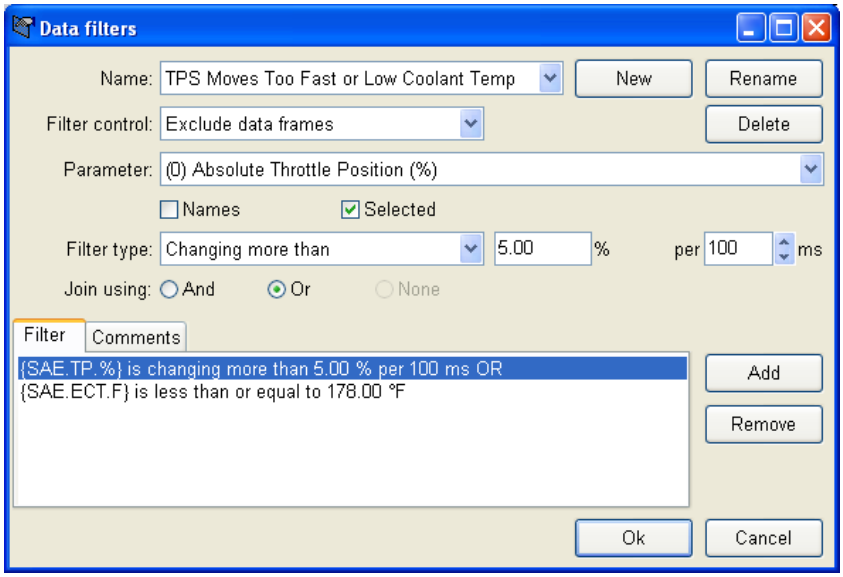
Update Calibration

1. Start the EFILive Tuning Tool software and open your current tune file.

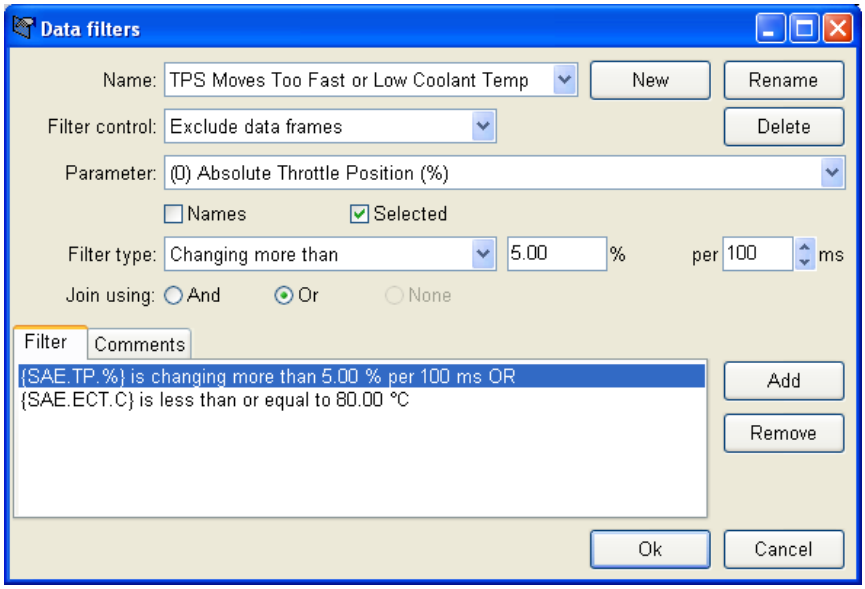
> Consider making a backup of your calibration before proceeding.

2. Start the EFILive Scan Tool software and open the Calc.VE.efi file.
3. Press F11 to display the [Maps (F11)] tab page.
4. Press A to display the CALC.VE_Table {B0101} map.
5. Click the Average button to display the cell's average logged values.

6. Build and apply the following filter which excludes unwanted frames from the data log:



Filter configuration using °F



Filter configuration using °C

7. Hide all cells with a value of less than 10.
8. Select all cells in the table by clicking in the extreme top-left grey cell, then right click and select ***Copy with labels (Shift+Ctrl+C)***.
9. Switch back to the EFILive Tuning Tool.
10. Open calibration {B0101} "Main VE Table".
11. Right click on any cell and select ***Paste->Paste with labels (Shift+Ctrl+V).***

	Note: VE table must be configured to display in the same units as is being used by the Scan Tool for CALC.VE_Table (i.e. “%” or “g*K/kPa”).

12. Switch back to the Scan tool and press B to display the CALC.LTFTBEN {B5001} map

13. Click the Average button to display the cell's average logged values.


14. Ensure the filters in step 6 are applied, and hide cells with a count of less than 10

15. Select all cells in the table by clicking in the extreme top-left grey cell, then right click and select ***Copy with labels (Shift+Ctrl+C)***.

16. Open calibration {B5001} "MAF Sensor Calibration"

17. Right click on any cell and select ***Paste->Paste and multiply with labels.***

18. Save your tune as:
My Documents\EFIlive\V7\Bins\Calc.VE_0000.tun

19. Perform a calibration only reflash of ***Calc.VE_0000.tun*** into the PCM.

20. Verify the results with a follow-up drive. Monitor the LTFT's and look for them to settle in the range of -1 to -3. If necessary, repeat steps 1-19 to fine tune the calibration.

Additional Considerations:

1. Table {B0120} “RPM Threshold For Airflow Calculation”:

   Change RPM Threshold to 400 RPM. This will eliminate the airflow correction that is applied from the VE Table B0101. The amount of airflow correction and its effects on LTFTs is complex. Most beginning users can leave the RPM Threshold at 4000 RPMs. Your LTFTs will update over time, so it is always best to perform additional Quality Control runs periodically.

2. Parameters {B3308} and {B3313} for Disabling DFCO:

   Set temperature to 140°C in both parameters. This will insure that the Airflow and LTFT values are being calculated with the Throttle engaged and the engine under load.

3. Table {B4105} “O2 Switch Point”:

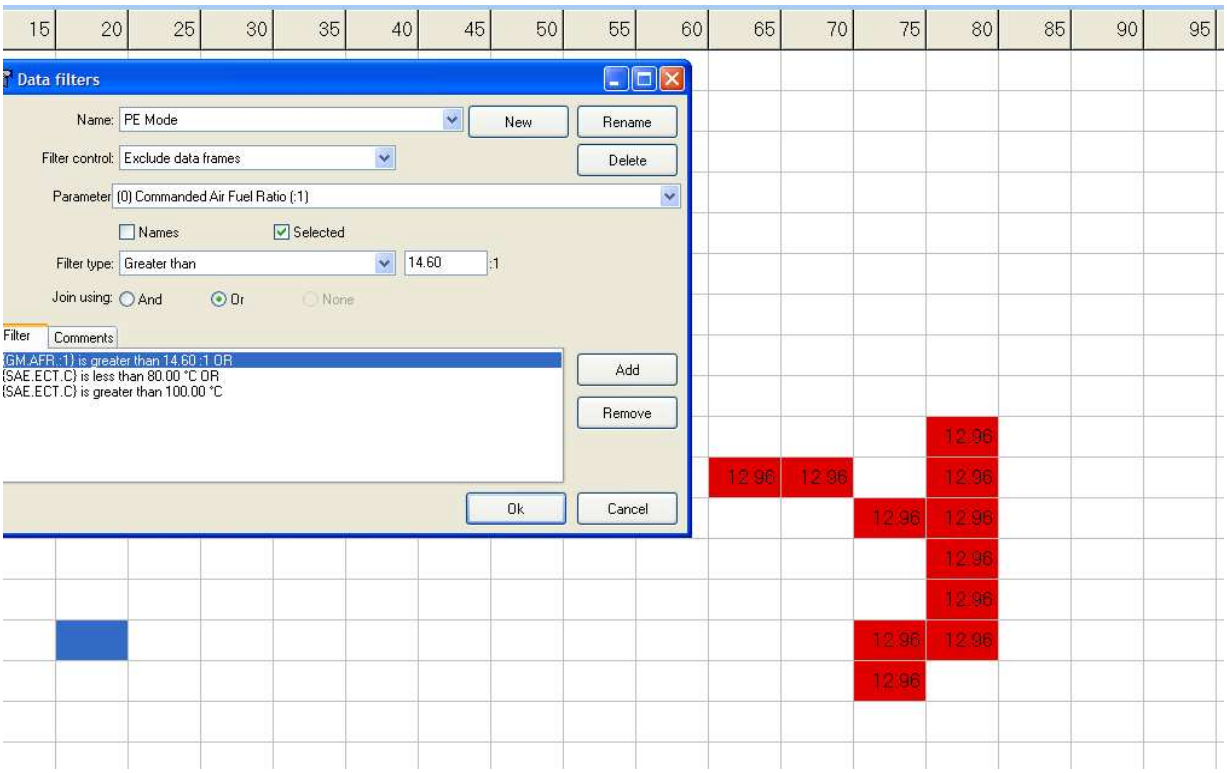
   Set all values to 450mv. This value (450mv) equates to 14.7 AFR and has been found to enhance the smoothness and the accuracy of the LTFTBEN values.

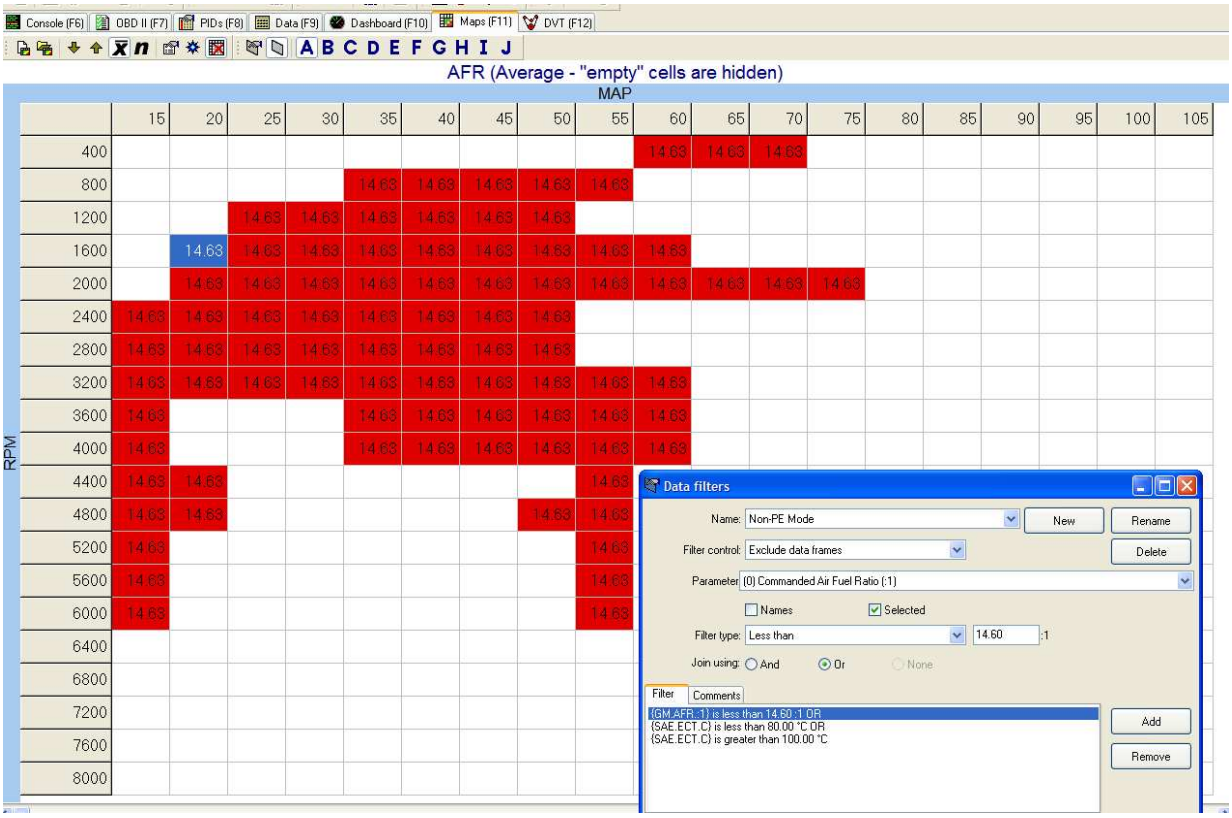
4. Enhanced Data Log Filters:

   The following set of filters will help smooth the VE Table, and eliminate the false spikes when performing a street tuning run.

   There are numerous filtering and smoothing techniques available to enhance the tuning experience. It is one of the more important aspects of creating an accurate VE Table and having a good tune. There are many resources online available to guide you on selecting proper filters.

   Here is an example of a filter to separate Power Enrichment Mode (PE) mode. The WOT portion of a tune usually requires a precise MAF and VE calibration. Eliminating any effect of positive LTFT’s into the WOT calibration will enhance your accuracy in your WOT AFR.


Data filters
Name: PE Mode
New
Rename
Filter control: Exclude data frames
Delete
Parameter (0) Commanded Air Fuel Ratio (:1)
Names
Selected
Filter type: Greater than
14.60
:1
Join using: And Or None
Filter
Comments
(GM.AFR.:1) is greater than 14.60 :1 OR
(SAE.ECT.C) is less than 80.00 °C OR
(SAE.ECT.C) is greater than 100.00 °C
Add
Remove
Ok
Cancel


Console (F6)
OBD II (F7)
PIDs (F8)
Data (F9)
Dashboard (F10)
Maps (F11)
DVT (F12)
AFR (Average - "empty" cells are hidden)
MAP
RPM
Data filters
Name: Non-PE Mode
New
Rename
Filter control: Exclude data frames
Delete
Parameter (0) Commanded Air Fuel Ratio (:1)
Names
Selected
Filter type: Less than
14.60
:1
Join using: And Or None
Filter
Comments
(GM.AFR.:1) is less than 14.60 :1 OR
(SAE.ECT.C) is less than 80.00 °C OR
(SAE.ECT.C) is greater than 100.00 °C
Add
Remove

Summary

In a MAF-enabled vehicle that utilizes a closed-loop function, you can easily calculate a representative VE Table. The model of the VE Table is being calculated from your MAF Airflow and the use of your LTFT Trim Function. Each Airflow model is virtually identical. There is no requirement to change your Tune (stock) parameters in order to utilize this method. With a wideband and functional O2 Sensors, an accurate VE Table and MAF Calibration can be performed with one logging session.

You are encouraged to explore more advanced options or a Custom Operating System if applicable.

A good way to check the quality of a MAF-Enabled Closed-Loop Tune is to perform a Closed Loop Speed Density Tune. Your VE Table values and LTFTs, along with your WOT AFR should be comparable to your 'MAF' tune.

The procedures to perform a CLSD are well documented on the EFILive Forum and found in many references.

Ultimately the most precise and accurate method of tuning for your VE Table is an Open-Loop Speed Density Tune, performed on a dyno. It is far easier to maintain the controlled environmental conditions and perform load-bearing tests on a dyno than on the street. Not only is it ultimately safer than street tuning, it is also a time-saving method.

Revision History:

March 01, 2010:

First Published.

March 28, 2010:

Revised equations, fixed typos.