CALC.VET Tuning Tutorial

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Tutorial

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Revised

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 of the EFILive Forum who analyses/derivation of the CALC.VE Equation(s) in terms of a log-able pid proved invaluable, and to mr.prick for his assistance in calculating Analog Wideband Lambda.

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 here:
   http://www.efilive.com/downloads/downloads_7.html

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. 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?15236-A-New-Twist-on-CALC.-VE-Table..Computing-the-Entire-VE-Table.

I. CALC.VET Tuning

1. Create Calculated PIDs

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

- CALC.CL
- CALC.WO2BEN
- CALC.LTFTBEN
- CALC.SELBEN
- CALC.VEN
- CALC.VET

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-00-032
factor          0         1          .0       "{GM.EQIVRATIO}=1

*CLC-00-110
factor          0.5       1.5       .4        "{GM.EQIVRATIO}*{EXT.WO2LAM1}"

*CLC-00-120
factor          0.5       1.5       .4        "({SAE.LONGFT1}+{SAE.LONGFT2})/200+1"

*CLC-00-220
factor          0.5       1.5       .4        "iff({CALC.PE}, {CALC.WO2BEN}, {CALC.LTFTBEN})"

*CLC-00-300
%               0.0       100.0     .2        "{SAE.MAF.gps}*({GM.DYNAIRTMP_DMA.C}+273.15)/{SAE.RPM}/{SAE.MAP.kPa}*3445.2/displacement()"
VE              0.0       2.468     .4        "{SAE.MAF.gps}*({GM.DYNAIRTMP_DMA.C}+273.15)/{SAE.RPM}/{SAE.MAP.kPa}*15"

*CLC-00-320
%               0.0       100.0     .2        "{CALC.SELBEN}*{CALC.VEN.%}"
VE              0.0       2.468     .4        "{CALC.SELBEN}*{CALC.VEN.VE}"

# ==============================================================================
*PRN - Parameter Reference Numbers
# --------------------------------
# See sae_generic.txt for more information on the *PRN section
#
#Code                    PRN     SLOT              Units          System           Description
#-----------------------  -------  ----------------  -------------  ---------------  ------------------------------------
CALC.CL                  F032    CLC-00-032        factor         Tuning           "Closed Loop (based on EQIVRATIO)"
CALC.WO2BEN              F110    CLC-00-110        factor         Tuning           "BEN from Serial WB"
CALC.LTFTBEN             F120    CLC-00-120        factor         Tuning           "BEN from LTFT"
CALC.SELBEN              F220    CLC-00-220        factor         Tuning           "BEN selected from WB or LTFT"
CALC.VEN                 F300    CLC-00-300        "%,VE"         Tuning           "Calculated VE, Not corrected"
CALC.VET                 F320    CLC-00-320        "%,VE"         Tuning           "Calculated VE, BEN corrected"
```

Note: To set displacement(): Open a Log File, Go to Edit- >Log File Information- >Vehicle Options, and next to Engine enter the displacement in CC, click Ok, and save the log file.

2. Select PIDs for CALC.VET

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..VET 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	SAE.RPM	Engine RPM
Fuel	GM.EQIVRATIO	Equivalence Ratio
	SAE.LONGFT1	Long Term Fuel Trim – Bank1
	SAE.LONGFT2	Long Term Fuel Trim – Bank 2
Spark	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.CYLAIR_DMA	Air Flow Grams/Cyl
	GM.DYNAIRTMP_DMA	Dynamic Air Temp
	GM.DYNCYL_DMA	Air Flow Grams/Cyl-Speed Density
Tuning	CALC.LTFTBEN	BEN from LTFT
	CALC.WO2BEN	BEN from Serial WB
	CALC.SELBEN	Ben Selected from WB or LTFT
	CALC.VET	Calculated VE, BEN corrected
	CALC.VEN	Calculated VE, Not corrected
	CALC.CL	Closed Loop (based on EQIVRATIO)
WO2-Serial	EXT.WO2LAM1	External Wideband Lambda
O2	GM.HO2S11	Heated O2 Sensor Voltage Bank 1-Sensor 1
	GM.HO2S21	Heated O2 Sensor Voltage Bank-2-Sensor 2

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

The final PID selection should look like this:

Description	Caption	Units	Default	System	Channels	Parameter
Absolute Throttle Position	TP	%	-	Throttle	1	SAE.TP
Air Flow Grams/Cyl	CYLAIR_DMA	Grams/cyl	-	Tune	2	GM.CYLAIR_DMA
Air Flow Grams/Cyl - Speed Density	DYNCYLAIR_DMA	Grams/cyl	-	Tune	2	GM.DYNCYLAI...
Air Flow Rate From Mass Air Flow Sensor	MAF	Grams/s,Lb...	Metric	Air	2	SAE.MAF
BEN from LTFT	LTFTBEN	factor	-	Tuning	0	CALC.LTFTBEN
BEN from Serial WB	WO2BEN	factor	-	Tuning	0	CALC.WO2BEN
BEN selected from WB or LTFT	SELBEN	factor	-	Tuning	0	CALC.SELBEN
Calculated VE, BEN corrected	VET	%,g*K/kPa	-	Tuning	0	CALC.VET
Calculated VE, Not corrected	VEN	%,g*K/kPa	-	Tuning	0	CALC.VEN
Closed Loop (based on EQIVRATIO)	CL	factor	-	Tuning	0	CALC.CL
Dynamic Air Temp	DYNAIRTMP_DMA	°C,°F	Imperial	Tune	2	GM.DYNAIRTM...
Engine Coolant Temperature	ECT	°C,°F	Metric	Temperature	1	SAE.ECT
Engine RPM	RPM	RPM	-	Conditions	2	SAE.RPM
Equivalence Ratio	EQIVRATIO	:1	-	Fuel	2	GM.EQIVRATIO
External Wideband Lambda	WO2LAM1	Lambda	-	WO2-Serial	2	EXT.WO2LAM1
Heated O2 Sensor Voltage Bank 1 - Sensor 1	HO2S11	mV	-	O2	1	GM.HO2S11
Heated O2 Sensor Voltage Bank 1 - Sensor 2	HO2S12	mV	-	O2	1	GM.HO2S12
Intake Air Temperature	IAT	°C,°F	Imperial	Temperature	1	SAE.IAT
Intake Manifold Absolute Pressure	MAP	kPa,PSI	Metric	Air	1	SAE.MAP
Long Term Fuel Trim - Bank 1	LONGFT1	%	-	Fuel	1	SAE.LONGFT1
Long Term Fuel Trim - Bank 2	LONGFT2	%	-	Fuel	1	SAE.LONGFT2
Mass Air Flow Raw Frequency	MAFFREQ	Hz	-	Air	2	GM.MAFFREQ
Retard Due to Knock	KR	Degrees	-	Spark	1	GM.KR

Note: Keep the pid channel count (shown at bottom of PIDs tab) to 24 or less for fastest logging sample rate.

3. Create CALC.VET {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 "Calculated VE, BEN corrected" from the Parameter drop down list box. Select the Calculated VE, BEN corrected that has the same units as your B0101 table (i.e. either “%” or “g*K/kPa”). Select the [Column] tab page and check the “Selected” and “Names” check boxes.
7. Select "Intake Manifold Absolute Pressure (kPa)" from the Parameter drop down list box.
8. Start the EFILive Tuning Tool Software (If it is not already started)
9. Open calibration {B0101} “Main VE Table”.
10. 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.VET.map***

VET g*K/kPa (Average - "empty" cells are hidden)

MAP kPa / RPM RPM

	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
400															
800						0.98	0.94	1.18	1.19	1.29					
1200			1.08	1.03	1.01	0.99	1.24	1.32	1.40	1.46					
1600		1.02	1.01	1.29	1.37	1.46	1.55	1.60	1.62						
2000		0.97	1.22	1.33	1.42	1.50	1.56	1.60	1.63						
2400	0.91	0.99	1.30	1.40	1.46	1.53	1.62	1.65	1.74	1.69					
2800	0.90			1.55		1.72	1.73	1.78	1.83						
3200	0.96	1.27							1.98						
3600	0.96								2.14						
4000	0.91											2.44		2.48	
4400	0.85											2.42		2.50	
4800	0.92													2.59	
5200														2.57	
5600														2.58	
6000															
6400															

To display units on a MAP: go to Map properties, on each of the Data,Row,Col, tabs, checkmark show units.

4. Create CALC.SELBEN {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 "BEN selected from WB or LTFT (factor)" 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”.
14. 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)***
15. 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.
16. Click the Save as button and save the map as:
    My Documents\EFILive\V7\Maps\Calc.SELBEN.map

SELBEN (Average)

	Value
2000	0.95
2125	0.95
2250	0.95
2375	0.98
2500	0.96
2625	0.96
2750	0.96
2875	0.96
3000	0.97
3125	0.97
3250	0.99
3375	0.99
3500	0.98
3625	0.98
3750	0.98
3875	0.99

MAFFREQ	
4000	0.99
4125	0.99
4250	0.99
4375	0.99
4500	0.99
4625	0.98
4750	0.98
4875	0.99
5000	0.98
5125	0.97
5250	0.97
5375	0.97
5500	0.98
5625	0.96
5750	0.96
5875	0.96
6000	0.97

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

5. 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 80℃ (176℉) 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.

6. Update Calibration

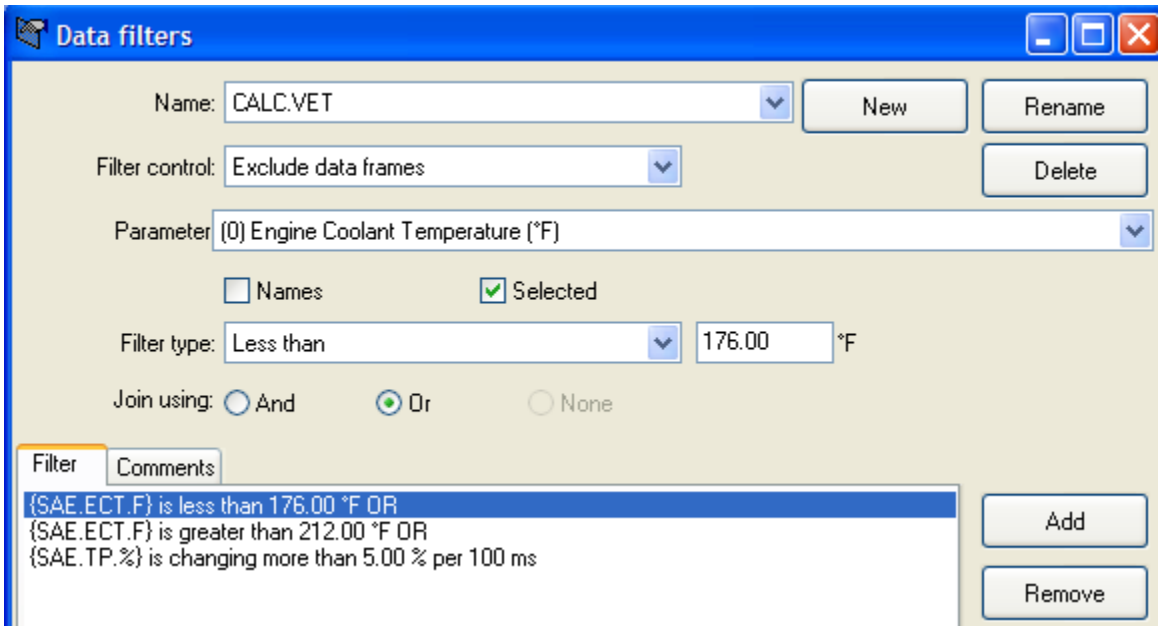
1. Start the EFILive Tuning Tool software and open your current tune file.

	Consider making a backup of your calibration before proceeding.

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

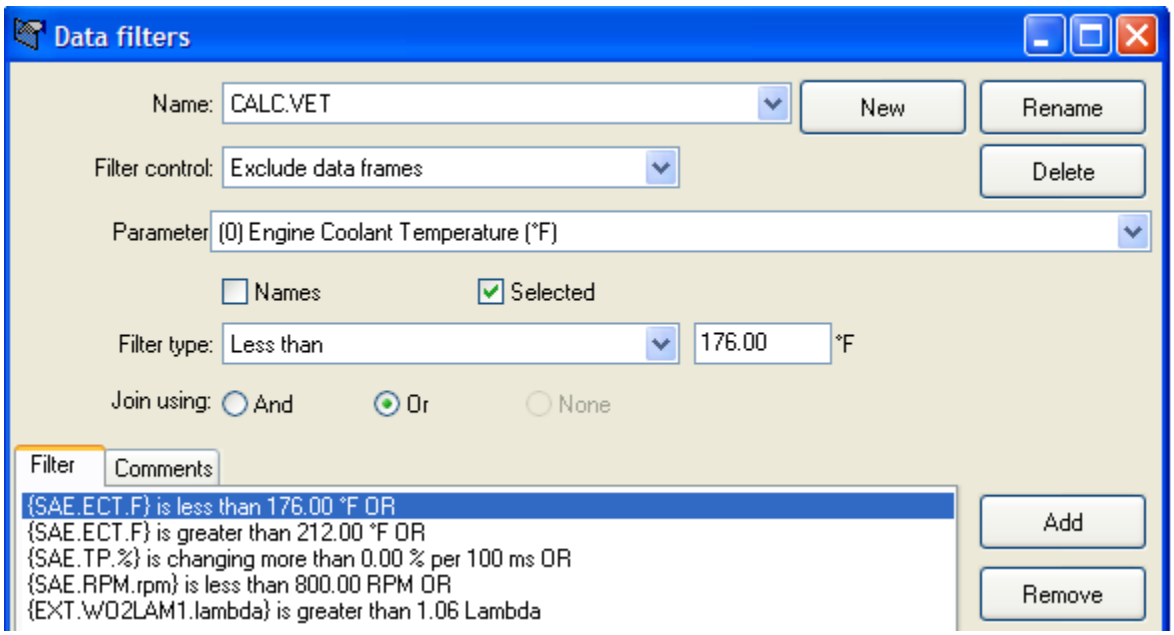
6. Build and apply the following filter which excludes unwanted frames from the data log

Loose Filter (More Data)



OR

Tight Filter (Filters out All Throttle Transients, DFCO, Stalls, Etc.)



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.VET (i.e. “%” or “g*K/kPa”).

12. Switch back to the Scan tool and press B to display the CALC.SELBEN {B5001} map
13. Click the Average button to display the cell’s average logged values.

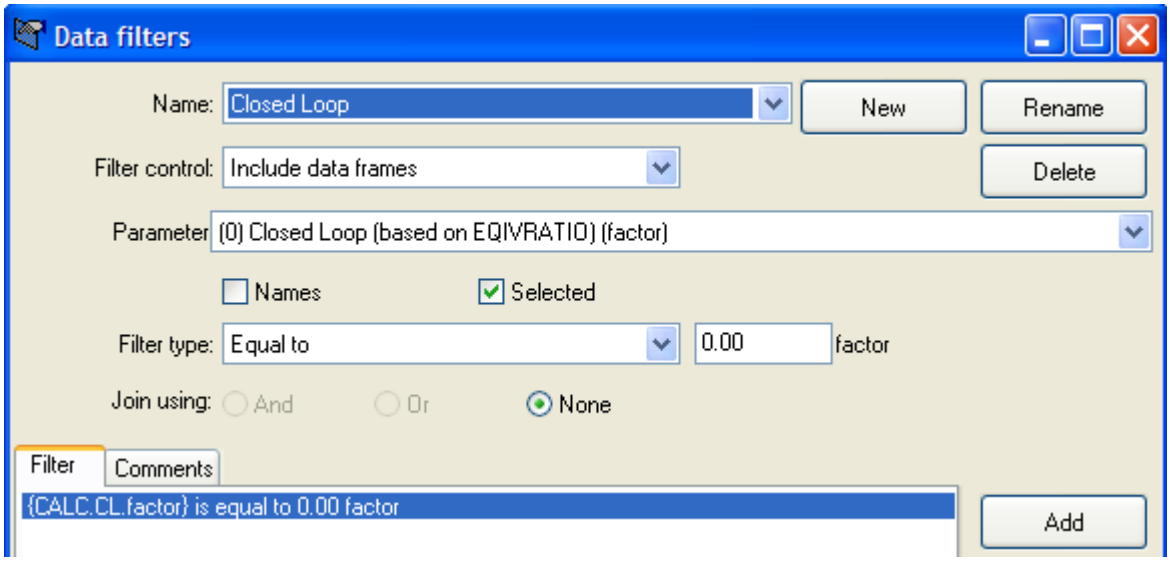
14. Ensure the filters in step 6 are applied, and hide cells with a count of less than 10
15. Select all cells in the table by clicking in the extreme top-left grey cell, then right click and select ***Copy with labels (Shift+Ctrl+C)***.
16. Open calibration {B5001} “MAF Sensor Calibration”
17. Right click on any cell and select ***Paste->Paste and multiply with labels.***
18. Save your tune as:
My Documents\EFIlive\V7\Bins\Calc.VET_0000.tun
19. Perform a calibration only reflash of ***Calc.VET_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.

II. CALC.VE Closed-Loop Tuning Only

NarrowBand Tuning (No Wideband)

For users who wish to Tune with only the Factory NarrowBands (NB) and have no Wideband available, CALC.VE can be used for the Closed-Loop Trim portion of the Tune only.

1. Select the same PIDS, MAPS, and Data Filters, as indicated for CALC.VET. Perform Identical Logging and Update Calibrations procedures as indicated for CALC.VET.
2. In Addition apply the following Data Filter to display Closed-Loop Tuning only.



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 stoich AFR and has been found to enhance the smoothness and the accuracy of the LTFTBEN values.

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 and Wideband readings. 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.

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