These instructions are written for the beginner and intermediate user of HP Tuners software. A wideband O2 sensor is required for the tuning described in these procedures.

If you have upgraded your fuel injectors, the injector data must be set correctly before you start. Read the Help files and Stickies on the HPtuners.com website. I cannot emphasize enough that you need to read the help section and the stickies so you can have an understanding of the various tables (I think over 400) that are in HP Tuners. You will not learn by everyone else doing the work for you, this is your responsibility.

Make sure you have the correct tire size and axle ratio loaded or your shifts points for automatic cars will not be correct.

Use these instructions are your own risk, proper understanding of the software and knowledge of the mods to the vehicle being tuned is critical. This information is from various sources on HP Tuners site, Wikipedia, LS1Tech and personal experience. Sources from the HP Tuners Forum are Cantelope Kid, EFI Calibrator, RWTD, and several others and the original Cpig’s HPT Tuning Guide. These fellow tuners are great assets to the tuning community. They are in no way affiliated with these instructions; I am solely responsible for its content.

Definitions:

**STFT** - Short Term Fuel Trim
The short term fuel trim is used by the control module in order to control the short term injector pulse width or the injector ON time. When the control module is in the Closed Loop mode, the control module monitors the heated oxygen sensor signals in order to determine if the fuel system is operating rich or lean. If the control module determines that no change in fuel delivery is needed in order to maintain correct short term fuel control for a particular engine operating condition, a short term fuel trim scan tool data value of 0 percent is indicated. If the control module determines that the fuel system is operating rich, short term fuel trim will compensate for the rich condition by decreasing the injector pulse width and a negative short term fuel trim value is indicated. If the control module determines that the fuel system is operating lean, short term fuel trim will compensate for the lean condition by increasing the injector pulse width and a short term fuel trim positive value is indicated.

When the control module is in the power enrichment (PE) mode, the short term fuel trim value will indicate 0 percent in order to prevent the fuel trim from compensating for the commanded rich condition of the PE mode.

**LTFT** - Long Term Fuel Trim
The long term fuel trim consist of groups of fuel control calibrations or cells. Each cell contains the short and long term fuel injector control values required to maintain the correct air and fuel mixture for a particular long term engine operating condition. The control module monitors the short term fuel trim values in order to determine if the short term fuel trim values are indicating a trend of rich or lean corrections to the fuel control. If the control module determines that the short term fuel trim is able to maintain control and is near 0 percent, the long term fuel trim within that particular cell will indicate a value of 0 percent. If the control module determines that the fuel
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VE - Volumetric Efficiency
VE is map of predicted engine performance based on speed and MAP. VE is how much cylinder filling occurs based on engine displacement. This value can be over 100%.

MAP - Manifold Absolute Pressure
The manifold absolute pressure sensor provides instantaneous intake manifold pressure readings to the computer to calculate air density and determine the engine's air mass flow rate, which in turn is used to calculate the appropriate fuel flow.

MAF - Mass Air Flow Meter
GM uses a Hot Wire MAF design. This is achieved by heating a wire with an electric current that is suspended in the engine’s air stream, not unlike a toaster wire. The wire's electrical resistance increases as the wire’s temperature increases, which limits electrical current flowing through the circuit. When air flows past the wire the wire cools, decreasing its resistance, which in turn allows more current to flow through the circuit. As more current flows, the wire’s temperature increases until the resistance reaches equilibrium again. The amount of current required to maintain the wire’s temperature is directly proportional to the mass of air flowing past the wire. The integrated electronic circuit converts the measurement of current into a frequency signal (Hz) which is sent to the ECU.

If air density increases due to pressure increase or temperature drop, but the air volume remains constant, the denser air will remove more heat from the wire indicating a higher mass airflow.

SD - Speed Density
The speed density system is best described as a calculation procedure used by the computer that uses predetermined operating parameter values, volumetric efficiency tables, and the known volume of fuel delivery required per combustion event for a single cylinder. Management of fuel and spark functions is based mainly on a predetermined range of preprogrammed data and also on real-time feedback data from an array of sensors.

The "speed" signal is based on the calculated volume of a single cylinder. The "density" signal is a function of temperature and pressure measurements. To determine an engine's fuel delivery requirements, the speed density system infers airflow from several monitored sources, including engine speed (in RPM), intake manifold absolute pressure (MAP, to determine load), intake air temperature (IAT), throttle position, the heated oxygen sensors, engine coolant temperature and battery voltage.

AFR - Air Fuel Ratio
AFR is the mass ratio of air to fuel present during combustion. When all the fuel is combined with all the free oxygen, typically within a vehicle's combustion chamber, the mixture is chemically balanced and this AFR is called the stoichiometric (Stoich) mixture. Gasoline engines run at 14.7:1 air to fuel ratio. Ethanol based fuels require changing your Stoich calculations to a richer value.
PE - Power Enrichment
Power enrichment tables are used when the VCM detects wide open throttle (WOT) operation and provides extra enrichment to achieve maximum power.

High Octane/Low Octane
Vehicle runs on the High Octane table unless engine knock is detected and then the Low Octane table is used. As a rule of thumb, the low octane table should be about 4x lower than the high octane table.

IFR – Injector Flow Rate
This value is the injector flow rate in g/sec. It is used to tell the VCM the size of the injectors and also how flow rate varies with manifold vacuum (ie. varying pressure characteristics). On a returnless system that have a non-vacuum controlled fuel pressure regulator, the IFR table will have an upward slope. On vehicles that have a vacuum regulate fuel pressure regulator, the IFR table will be flat with fix pressure. There is an excel spreadsheet available that will help you build the IFR table if you know the values of your current injector, new injectors and at what pressure they are rated at, and the current fuel pressure. This is a critical setting for all of your tuning.

Fuel Trim Cells LS1 V8
0 - 15 defined by the LTFT RPM and MAP boundaries
16 - Idle PN (AC on)
17 - Idle PN (AC off)
18 - Idle In Gear (AC on)
19 - Idle In Gear (AC off)
20 - Idle (EVAP closed)
21 - Coast down (EVAP closed)
22 - Non-Idle (EVAP Closed)

Open Loop
Open Loop fueling means that the oxygen sensors are not being used to control fueling and the VE table and Open Loop Fuel Air (OLFA) table are doing the primary fueling control.

Closed Loop
Closed loop fueling means that the oxygen sensors (O2) are being used to adjust fueling to keep the AFR at stoich. The O2 sensors must be at operating temperature, the engine coolant temperature (ECT) must meet the set parameter in the computer.

Diagnostic Trouble Code (DTC) Error Modes
Used for turning ON/OFF DTC’s
0 - MIL on First Error: Emissions related. Illuminates MIL the first time DTC sets.
1 - MIL on Second Error: Emissions related. Illuminates MIL, if fault is active for 2 consecutive drive cycles.
2 - No MIL Light: Non-emissions related. Does not illuminate MIL, but will illuminate SERVICE light.
3 - No Error Reported: Non-emissions related. Does not illuminate MIL or SERVICE light.
Connect your vehicle to HP Tuners.

1. Go to Flash – Read Entire and copy your stock tune and save it in a different folder than you work in so the file does not get overwritten.
2. Do a Save As on the file and name SDtune.

   ![Flash interface](image)

   ➢ Used to save a copy of your entire tune and operating system

3. Engine – Idle – Idle RPM – Target Idle Speed – Set the idle cells to at least 850 -950 if you have a cammed engine.

   ![Target Idle Speed vs. Coolant Temp](image)

   ➢ Table used to set your desired RPM’s at idle

4. If you have a cam and other airflow mods, do the following. Engine – Idle – Idle Airflow – Base Running Airflow – Idle Airflow – Add 4 to each cell to get you started, this should help with your initial idle settings.

   ![Idle Airflow vs. Coolant Temp](image)

   ➢ Table used to correct Idle Airflow
5. **Engine Diagnostics – DTCs** – Set P0103 to 2-No MIL Light. Click your mouse on the words and a drop down arrow will appear, click arrow and the choices show up.

- Used to assure MAF is failed but does not cause Service Engine Soon light.


- Table used to fail MAF so not MAF data is used to correct fueling issues.

7. Do this is it’s the first time tuning on a fresh build - **Engine – Main VE – Primary VE** – select all – multiply table by 1.15 to cover for a potentially lean condition if you modded the engine.

   **Normal** – set Enable Temp to 284°F.

   ![Fuel Cutoff Table]

   ➢ Table used to disable DFCO so data is not skewed with false fueling issues

9. **OL & CL – EQ Ratio** – select columns 140 through 230 – put 1 in white box at top and click =. By making those cells 1, your PCM’s stoich value will be the target for fueling. Vehicle needs to at operating temperature before tuning VE table

   ![OL & CL Table]

   ➢ This table sets the Closed Loop fueling multiplier to so you are tuning to Stoich.


   ![OL & CL Table]

   ➢ Disables all fuel trims from working so no corrections are made while tuning.
12. **OL & CL – Closed Loop - Closed Loop Enabled** – select all – type 284 in box and click =.

- Tables used to force Open Loop mode.

13. **Fuel Control - Power Enrichment – Power Enrichment – EQ Ratio vs. RPM** – set to your desired PE ratio for WOT. Example, if your Stoich is 14.63 and you set the PE to 1.13, you commanded AFR for WOT will be 12.95. Safe for NA, should be in the 11 -11.5 range for blower/turbo setups. Flat lining this is not a bad thing to do, you will see tunes that are all over the place, that is not correct.

- This table is the Power Enrichment table that is used for WOT fueling.

![Gen III VE Table](image)

- This table is for catalytic converter protection, it is disabled so fuel is not added during tuning.

15. **Spark Control** – **Spark Advance** – Open High Octane Table, select all and copy. Open Low Octane table, select all, paste. This assures timing stays steady.

![Spark Control Table](image)

- These are the two spark tables, copying the high to low will eliminate the possible of timing being pulled do to spark knock issues.

16. **Flash** – **Write Calibration Only**, do not write Entire.

17. Open the HP Tuners scanner.
18. Choose the PIDS you want to log. Do not log MAF data while VE tuning, keep it simple. Here is one I use.

<table>
<thead>
<tr>
<th>PIDS</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine RPM (SAE)</td>
<td>Idle Advance</td>
</tr>
<tr>
<td>Vehicle Speed (SAE)</td>
<td>IAC Desired Position</td>
</tr>
<tr>
<td>Throttle Position (SAE)</td>
<td>IAC Position</td>
</tr>
<tr>
<td>Ignition Timing Advance (SAE)</td>
<td>NGK wideband</td>
</tr>
<tr>
<td>Knock Retard</td>
<td>EGR Position</td>
</tr>
<tr>
<td>Burst Knock Retard</td>
<td>NGK AFR error</td>
</tr>
<tr>
<td>Manifold Absolute Pressure (SAE)</td>
<td>Air Fuel Ratio Commanded Lo Pe</td>
</tr>
<tr>
<td>Engine Coolant Temp (SAE)</td>
<td></td>
</tr>
</tbody>
</table>
19. Create a VE AFR Error % histogram.

20. Start logging data, drive at very steady speed so the engine stays in “Steady State”, do not go WOT or do rapid throttle changes until the VE table has been tuned up to at least 4000 rpm’s.
21. After logging a minimum of 20 hits in as many cells as possible, copy all data from the VE histogram. You will not be able to hit every cell so don’t get too worried about that part.

- This is the VE histogram data that is logged while test driving. Populate as many cells as possible.

22. Open the Editor, open the Primary VE table, select all cells by clicking the empty cell at the top left of the table, right click the same cell. Select Paste Special, Multiply by %. If your values in the scanner have moved below 10, select Multiply by % - Half so you do not over correct the table. If you have very high spikes or deep valleys, select the cells around the spike or valley and click Smooth, this will help minimize the issue.

- This is the Primary VE table in the editor that you copy and paste special the data from the scanner histogram into.

23. If you have an operating system (OS) that has a secondary VE table, copy the even rows from the primary table over to the secondary table. During SD mode, the computer uses the secondary VE table for fueling data.
24. Save the file and Flash Calibration Only and re-drive and log more data. Once you have adjusted the VE table up to 4000 rpm’s you can try some higher MAP/RPM/WOT runs, perform the copy and paste steps from above until you log no higher then 2-3 in any cell. 0-1 will be the best you will get, shoot for that if you can. Hand smooth as needed to keep the table relatively smooth, don’t get carried away with it being as smooth a production table, remember, your engine has been modified so it will have different needs now than before.

25. **Open your stock original file and do a Save As and rename Aftertune_date.**
26. **Copy the VE table(s) from your SD file to the newly saved stock file, this will save you from having to reset all of the various table settings you did to enter SD mode.**
MAF Only Tuning

Now that the VE table is all tuned, its time to turn everything back to normal. Follow the initial steps and reset all values to stock for the temps, OL, CL settings, DTC’s MAF Fail etc.

We will now move on to tuning the MAF if you are going to use one. Follow these steps to tune in MAF Only mode. By tuning the VE separate and then tuning the MAF separate you will end up with a tune that will transition very well during throttle transitions. These steps will force Open Loop MAF Only tuning.

1) Open the Aftertune_date you just created and rename OLMAF.
2) **OL & CL – Closed Loop Closed Loop Enabled** – select all – type 284 in box and click =.

![Image](image.png)

> Table used to force Open Loop mode.

3) **Engine – Airflow – Dynamic Air – Steady State – Hi/Lo RPM Thresh** – set to 0 (zero).
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- By setting the Hi/Lo RPM Thresh to 0 will for the computer to use the MAF Only and not reference the VE table so you can properly tune the MAF with no outside fueling references.

4) Create a PID table for MAF Only tuning.

<table>
<thead>
<tr>
<th>Engine RPM (SAE)</th>
<th>O2 Voltage E1S1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throttle Position (SAE)</td>
<td>O2 Voltage E2S1</td>
</tr>
<tr>
<td>Vehicle Speed (SAE)</td>
<td>Short Term Fuel Trim Bank 1 (SAE)</td>
</tr>
<tr>
<td>Ignition Timing Advance (SAE)</td>
<td>Short Term Fuel Trim Bank 2 (SAE)</td>
</tr>
<tr>
<td>Knock Retard</td>
<td>Long Term Fuel Trim Bank 2 (SAE)</td>
</tr>
<tr>
<td>Manifold Absolute Pressure (SAE)</td>
<td>INJ. Pulse Wtch Avg. Bank 1</td>
</tr>
<tr>
<td>Mass Air Flow (SAE)</td>
<td>INJ. Pulse Wtch Avg. Bank 2</td>
</tr>
<tr>
<td>Mass Air Flow</td>
<td>EGR Position</td>
</tr>
<tr>
<td>Dynamic Cylinder Air</td>
<td>NGK AFR error</td>
</tr>
<tr>
<td>Dynamic Airflow</td>
<td>NGK wideband</td>
</tr>
<tr>
<td>Injector Duty Cycle</td>
<td>Air Fuel Ratio Commanded Hi Rea</td>
</tr>
</tbody>
</table>

- PID table used to choose what monitored and used in the histograms. Must be in this table to be used in histograms.

5) Setup a MAF AFR Error Histogram.

- This one filters out DFCO data that will skew the histogram data.
6) Flash the tune to the PCM, **Calibration Only**.
7) Start the scanner and beginning logging data. Just like the VE table tuning, steady speed/throttle driving will give you the best results.
8) Copy the data from the histogram above and Paste Special – Multiply by % - just like the VE table. By half if less that 10 as before.

9) Re-flash the computer with a Calibration Only mode and re-drive again. Keep scanning and editing the tune file until you see 0-1 in the histogram cells. Remember to hand smooth here also, there should be no spikes or valleys. It does not have to be perfectly smooth like the factory, CAI, intakes, cams, heads, etc will create different demands and airflow requirements.
10) When completed with the MAF tuning, go to the **Engine – Airflow – Dynamic Air – Steady State – Hi/Lo RPM Thresh** – set to 2400 or whatever your file had in your stock cam.
11) **OL & CL – Closed Loop**

Closed Loop Enabled – reset -40 to -4 to 140 and the rest to 94.

12) Everything is now back on so its time to re-drive and log some more data. Build a new PID table and setup the histograms you want to log. Here is one config file that I use. It tracks MAF, IAC, various timing and knock data points.

<table>
<thead>
<tr>
<th>Engine RPM (SAE)</th>
<th>02 Voltage B1S1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Speed (SAE)</td>
<td>02 Voltage B1S1</td>
</tr>
<tr>
<td>Throttle Position (SAE)</td>
<td>IAC Desired Position</td>
</tr>
<tr>
<td>Ignition Timing Advance (SAE)</td>
<td>IAC Position</td>
</tr>
<tr>
<td>Knock Retard</td>
<td>Mass Air Flow</td>
</tr>
<tr>
<td>Burst Knock Retard</td>
<td>Mass Air Flow (SAE)</td>
</tr>
<tr>
<td>Knock Lean Factor</td>
<td>Manifold Absolute Pressure (SAE)</td>
</tr>
<tr>
<td>Base Advance</td>
<td>Dynamic Airflow</td>
</tr>
<tr>
<td>Engine Coolant Temp (SAE)</td>
<td></td>
</tr>
<tr>
<td>Intake Air Temp (SAE)</td>
<td></td>
</tr>
<tr>
<td>NGK wideband</td>
<td>Short Term Fuel Trim Bank 1 (SAE)</td>
</tr>
<tr>
<td>NGK AFR error</td>
<td>Short Term Fuel Trim Bank 2 (SAE)</td>
</tr>
<tr>
<td>Air Fuel Ratio Commanded Hi</td>
<td>Long Term Fuel Trim Bank 1 (SAE)</td>
</tr>
<tr>
<td>EGR Position</td>
<td>Long Term Fuel Trim Bank 2 (SAE)</td>
</tr>
</tbody>
</table>

13) You should see hardly any cells above 2-3 (hopefully 0-1) in the VE and MAF histograms if the first two steps above went well and you tuned the VE and MAF correctly. You can leave the 2-3 or you can set up the VE – STFT histogram and the MAF – STFT histogram and do some very minor fine tuning in the cells as needed. Do individual cells if they are high and hand smooth when done. Just like before, copy the data from the histogram and Paste Special, Multiply by % - Half. Do not use the Multiply by %, it will go too far.

14) Open the Aftertune_date file and copy the MAF table data from CLMAF into Aftertune_date and save file.
IAC Relearn Procedure

If you are having idle issues you may need to reset your Idle Air Control (IAC) and TPS, do this before you start drilling holes in your throttle body (TB) blade. I have used this procedure on some huge cammed cars and it worked.

1) Monitor your IAC, Idle Speed, throttle position voltage and your throttle position %.  
2) With the key in the ON position, adjust your TB set screw until your throttle position is 2%.  
3) Turn your key to the OFF position.  
4) Unplug your Throttle Position Sensor (TPS) and IAC.  
5) Turn your key to the ON position for a few seconds, and then OFF again.  
6) Plug in the TPS and IAC and then turn your key to the ON position and restart logging. Your throttle position will now be reset to 0 degrees and about .45-.55 volts.  
7) Start your engine, your IAC should be 40-60 for a cammed engine.

If you are not at your desired IAC position, redo the above procedures in smaller increments.

DELETING REAR O2 SENSORS:

In Editor, go to ENGINE DIAGNOSTICS>DTCs

Under the far right column under Error Mode set these to “3-No Error Reported”

Driver Side
137 - HO2S Circuit Low Voltage Bank 1 Sensor 2
138 - HO2S Circuit High Voltage Bank 1 Sensor 2
140 - HO2S Circuit Insufficient Activity Bank 1 Sensor 2
141 - HO2S Heater Performance Bank 1 Sensor 2
420 - Catalyst System Low Efficiency

Passenger Side
157 - HO2S Circuit Low Voltage Bank 2 Sensor 2
158 - HO2S Circuit High Voltage Bank 2 Sensor 2
160 - HO2S Circuit Insufficient Activity Bank 2 Sensor 2
161 - HO2S Heater Performance Bank 2 Sensor 2
430 - Catalyst System Low Efficiency Bank 2
Spark and Timing Control

If you want to eliminate all of the torque management spark reduction, including transmission, zero out this table. This will cause more stress on your transmission so use with caution unless you have a known good transmission. Look for other tables that have a maximum torque value, usually 640 and put the max value in all of the cells. This varies by vehicle and operating system.

- This table is used to adjust torque management and will affect the feel of the car and the crispness of the shifts.