COBB TUNING™
AccessTUNER

USDM/CDM 2006-2009 Honda Civic Si
Tuning Guide and Table Descriptions
v1.05

Tuning Guide

This tuning guide is broken into the basic components of tuning a 2006-2009 Honda Civic Si and the tables associated with each of these components. For each major tuning category, the tuning guide outlines basic tuning strategies and defines tables within this category (for example, Camshaft Phasing, Fueling, VTEC, and Ignition calibration).

Table of Contents

Step 1 – Please update your AccessPORT firmware and review some helpful documents.

Please be sure to update the firmware on your AccessPORT to the latest firmware by following these instructions = http://www.cobbtuning.com/info/?ID=4481

Please review the Civic Si FAQ link. This page contains answers to frequently asked questions, general information about the Civic Si, and other suggestions about what procedures can be followed for proper dyno testing and tuning.

We also have links to the following:
Honda Civic Si AccessPORT Quick Start Guide

We have also included a Honda HelpFile that you can access by pressing the F1 key while the software is open. We have written a detailed description for all tables, tuning tips for most tables, and a complete tuning guide. Please take into consideration that the engineers who established these calibrations did so in a very scientific manner and most of these calibrations are optimal already.

How do I properly dyno test various maps?

This process is a bit more time consuming due to the nature of testing a normally aspirated (NA) vehicle. Dyno testing with 2-3 WOT pulls will not be sufficient for recording the power output of a stock or performance map. Our experience has shown that these and other NA vehicles need be be tested several times in a row, usually 3-4 on a Dynopack hub dyno and 5-8 on a Mustang chassis dyno, in order to perform consistently. This is necessary in order to bring the coolant (engine coolant temperature or ECT), engine oil, transmission oil, and combustion chambers to the appropriate temperatures for consistent results.

You can see the results from dyno testing are consistent when you overlay two power curves and they are within 1 HP & TQ of each other across the entire RPM range. An engine will usually make less power on the first few runs after a reflash (unless the intake manifold (or ambient air) is super cold or cools down very quickly), and less power after heat soak has set in. This is normal.

An NA engine will likely produce additional power as it is run until the power curves recorded by the chassis dyno are consistent. Please take into account that the number of WOT dyno pulls necessary to allow for consistent performance will vary based on the type of chassis dyno used, the ambient weather conditions, and the airflow capability of the fans used during the testing.

Ideally, a full wide-open-throttle (WOT) pull should be made then the vehicle should be allowed to sit with the engine at idle for a minute or so between runs. This will allow the dyno fans to cool down the fluid in the radiator. When the engine is ready to be run again, you can use the AP to watch coolant temperature. You will want the starting coolant temperature to be around 185F (85C), and not to exceed 203F (95C), in order to provide a consistent environment for chassis (or engine) dyno testing. If necessary, you can rev the engine by gradually blipping the throttle between 3500-5500 RPM about 4-7 times in a row or you can run the internal heater for about 30 seconds. This will allow the colder (relatively) coolant in the radiator to be exchanged with the warmer coolant in the engine block. You can watch the Coolant Temperature on the AP display drop during this process. The coolant temperature will likely drop to a minimum floor, around 180-190F (82-91C). The vehicle is ready for WOT dyno testing at this time. If additional cooling is necessary, you can turn the engine off, then turn the key to the ON position without the engine running then also turn the A/C on. This will activate the air conditioning fans and you can allow these fans to run for just over a minute to help cool the coolant in the radiator while the engine is not running.

You want to start each dyno pull within consistent Coolant and Intake Air Temperatures (IAT). Again, you want the starting coolant temperature to be ~185F (85C), and not to exceed 203F (95C), and the IAT to be within a few degrees of each other at the beginning of the runs in order to provide a consistent environment for chassis (or engine) dyno testing.

Please note: If the vehicle is not in proper mechanical condition (tire pressures are appropriate and consistent, engine oil needs to be changed, valve adjustment necessary, etc.) then the dyno testing results may not be consistent or valid.

Step 2 – What is the mechanical configuration of the vehicle, and some guidance with what is the appropriate base map to start with?

Please start with a standard base map that best fits the hardware installed on your vehicle. You can read the long description of the base map to see what hardware the map was designed for.

Civic Si Base Maps and Map Notes = http://www.accessecu.com/accessport/honda/AP-HON-001/06-09SiMaps.html

The Stage1 calibrations are designed for vehicles with a stock or aftermarket intake and stock or aftermarket exhaust system. The Stage2 calibrations are designed for vehicles with a common intake, header, and exhaust system (IHE) configuration. This major difference in configuration impacts the pumping efficiency of the engine and critically impacts all major aspects of tuning (camshaft phasing, VTEC engagement, fuel, and ignition).

Please note, higher octane fuels burn more slowly and can support higher cylinder pressure. This difference in fuel will somewhat determine how the car is tuned. Higher octane fuels support more ignition timing, higher boost levels, and leaner air to fuel mixtures compared to lower octane. We highly suggest you use higher octane fuels (91+) when tuning Forced Induction (FI) applications.

Step 3 – What type of air intake is on the vehicle?

The Civic Si utilizes a Mass Air Flow (MAF) sensor located downstream of the air filter and before the throttle body to measure the mass of air entering the engine. This air flow measurement IS CRITICAL for camshaft phasing, ignition, and fueling look-ups. The MAF sensor reports the amount of air entering the engine and this is used to help determine load. Many tables inside the ECU use calculated load and engine speed as look-up axes. Therefore, it is the MAF sensor reading and calculated load that determines the table values used to control the engine.

The MAF sensor readings depend entirely upon the type of intake system. After market intakes rarely promote laminar airflow around the MAF sensor that is equivalent to the stock system. As a result, the stock MAF sensor calibration is not appropriate for most after market intakes. If an after market intake is used, the tuner will have to spend considerable effort to ensure that the MAF sensor calibration matches the true airflow characteristics of the chosen intake. We highly suggest that the initial tuning is done with the stock intake system so that a proper tune can be established with a known MAF sensor calibration. Once the tune is optimized for the stock intake the aftermarket intake can be installed and only those components of the tune related to this intake change need be altered.

Cobb Tuning offers maps that support the stock intake as well as the several different aftermarket intakes. If a calibration is not available for your intake you will have to go through a deliberate process to create MAF sensor calibrations. Please see the tuning tips under "MAF sensor calibration" where this process is outlined.

Step 4 – Calibration refinement on a chassis dynamometer.

A: Complete MAF calibration revision(s) prior to visiting your local chassis dyno facility. This is important to complete prior to tuning the vehicle on a chassis dyno. This will allow load calculations to be more accurate and for fueling to be closer to the targeted 13.1:1 AFR petrol for the NA calibrations. This will allow easy fueling changes to be made through the main fueling tables.

STEP A - How to set up the AccessPORT or AccessTUNER software to capture the correct information for a MAF calibration revision.

If your LTFT values are exceeding +/- 8%, then we suggest you complete the follow MAF calibration datalogging, analysis, and MAF calibration revision. You want to make sure the following variables are checked for data logging. These variables are the 10 default variables (on the AccessPORT) with the inclusion of STFT, which you will have to add:

Actual AFR (AFR, lambda, AFR)
Calculated Load (load, load, load)
Coolant Temp. (F, C, C)
Fuel Trim (Long) (%, %, %)
Fuel Trim (Short) (%, %, %) = Please be sure to add to your log list.
Ignition Advance (deg, deg, deg)
MAP (PSI, kPA, kPA)
Mass Airflow (g/s, g/s, g/s)
RPM (RPM, RPM, RPM)
Throttle Position (%, %, %)
VTEC Status (ON, OFF)

The variables in bold are actually the only ones necessary for a MAF batch datalog. We have noted this because the AP will log at higher sample rates with fewer variables logged. Although, it is not critical to just log those items as long as you collect an appropriately long datalog that has sufficient information.

After you have reflashed the map that best matches the performance hardware installed on your vehicle. We suggest you street drive at light to moderate throttle for a minimum of 10 minutes or 10 miles. Turning the vehicle fully off and on at least twice during this period is helpful (please do not turn the vehicle off while you are driving, simply pull over in a parking lot and turn the car off, then back on). This will allow the ECU to learn initial fuel trims. After this learning period, if you notice that your fuel trims (specifically LTFT) are exceeding + or - 8%, then please complete the following datalogging procedures so that appropriate datalogs can be recorded and analyzed using the following steps.

This test should be done carefully. Allow the vehicle to idle for a few minutes, then drive for about 10 city miles at light to moderate throttle (as noted above). Please make sure the ECU has not been reset or the battery disconnected for these 10 miles. Set the AccessPORT up to datalog the standard 10 AccessPORT variables along with Fuel Trim (Short) or STFT. This variable will need to be added to the datalog list. Be sure to have Mass Airflow displayed on the AccessPORT screen or AccessTUNER dashboard as you prepare to capture this datalog. Start driving the car around under light throttle conditions so the ECU can calculate what changes need to be made using the closed-loop feedback system. While driving, try to modulate the throttle so the MAF Airflow values vary from 8-20 grams/sec (a normal airflow value for light throttle) to 80 grams/sec over the next 5-10 minutes; please be sure to accelerate at a steady rate until you exceed 80 grams/sec airflow. It is likely that you will need to modulate the throttle to full throttle to exceed 80 grams/sec during this test, this is normal. You do not need to exceed 4800 RPM or the VTEC engagement point during this datalogging period. After you have completed sufficient driving for this log that modulates MAF Airflow between 2-80 grams/sec, please put the car in neutral and allow the car to idle for almost a minute, then stop the datalog. This will allow us to see what type of fuel trim learning the ECU is doing to compensate for the fuel being run through the engine, the intake system, and other hardware that is installed on this car. Ideally, you want your LTFT values to be closer to zero. Anything within +/- 8% is acceptable, but closer to 0% LTFT is ideal.

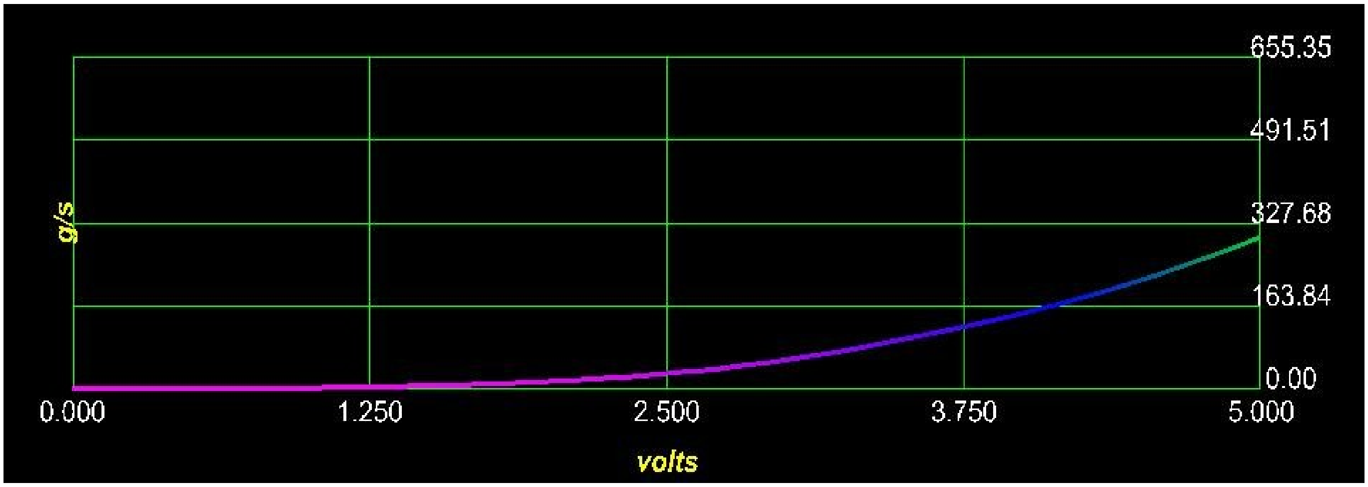
The objective is to observe the various adjustment that have been saved by the ECU at various breakpoints along the MAF curve. With this information, you will be able to fine tune your MAF calibration.

Again, this is really nothing to panic about. If your vehicle is running leaner than desired or is safe, then simply stay out of WOT and heavy loads. For you to optimize your map based on your datalogs is very simply. You will literally go into a MAF sensor calibration table, apply the LTFT learning values appropriately (based on your recorded datalog), save the map and reflash it on your ECU using the AccessPORT. You install this new map and vuola, your LTFT values will now be closer to zero and your WOT fueling is at to or closer to the targeted 13.1 AFR petrol. It may take 2 to 5 MAF calibration revisions to get the calibration performing more consistently. It may be that you need to modify your mapping as you continue to install various parts on your vehicle. I have attached a Sample MAF Batch Analysis spreadsheet that you can look at for reference.

Generally speaking, if your WOT fuel curve is within +/- 4% of 13.1 AFR petrol, we see no reason to modify a map. If your LTFT values are within +/-8% while driving at part throttle, this is an acceptable range. If your LTFT values exceed +/- 8%, you are welcome to use the AccessTUNER and follow these steps to modify a map for your specific vehicle.

STEP B - How to organize the data in the datalog.csv in order to allow for appropriate analysis.

- First, use a spreadsheet program to open your .csv file.
- Re-save the file as a spreadsheet file (.xls for MS and .ods for OO) so your advanced functions and graphs will save appropriately.
- Copy the Fuel Trim (Long) (%), Fuel Trim (Short) (%), and Mass Airflow (g/s) column so you can paste them to the right of the existing information. We have done this in the above sample MAF Batch Analysis spreadsheet (we italicized the text with a blue back-ground color).
- Highlight these three columns and sort them in ascending order by Fuel Trim (Short) (%).
- Copy and paste the data rows that have negative (-) or positive (+) STFT values to the right again. We have done this in the sample sample MAF Batch Analysis spreadsheet (text in bold with a green back-ground color). By eliminating the rows of data that has 0% STFT data, you are eliminating data that was recorded while decelerating or while in open-loop fueling, this data is not useful for MAF calibration refinement.
- Highlight this second set of three columns and sort them in ascending order by Mass Airflow (g/s). This will arrange the data in a manner that will allow you to analyze your accumulative STFT values with the corresponding Mass Airflow (g/s) values. This information will be used to analyze what changes you should make to your MAF calibration in the AccessTUNER software, see below Step 3.



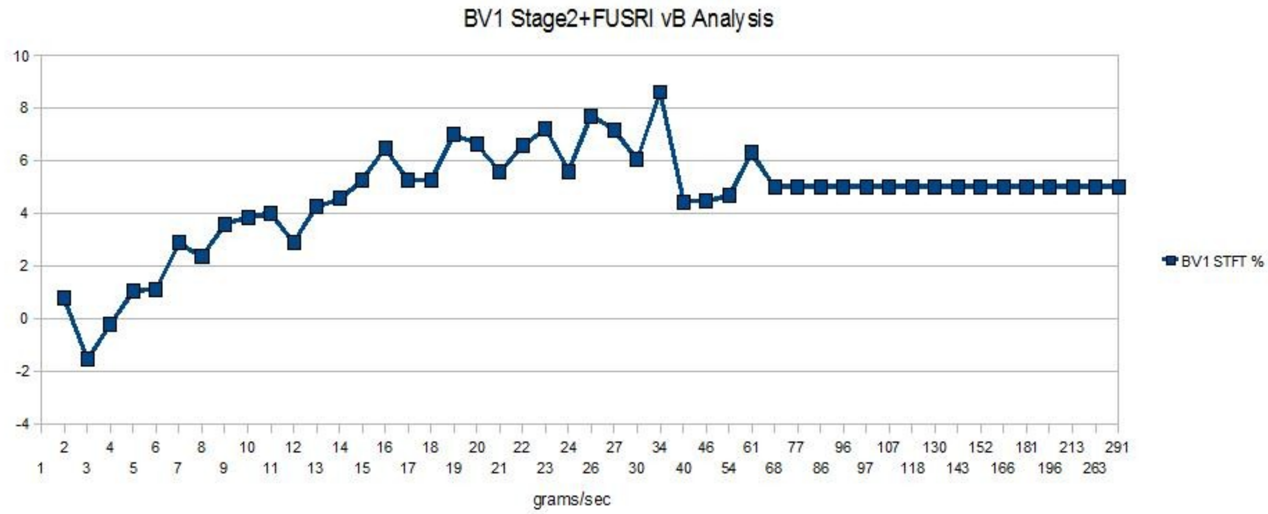
STEP C - How to apply fuel trim data to your MAF calibration in order to fine tune your MAF calibration.

This next step is a bit complex, but very easy to understand once you have reviewed the information on the spreadsheet. For each gram/sec breakpoint value (2.00 - 2.99, 3.00-3.99, 10.00-10.99, etc.), you want to sum up the STFT values and divide them by the number of samples that are being summed. You can see these analysis points have been highlighted with a red back-ground, the text is in bold and has been centered. You can go to these summation points and press the F2 key to see the math equations that we have already entered. These equations can be modified to include different data points that match the data you have logged. This step uses an average of the summarized data in order to determine what percentage corrections need to be applied to the MAF calibration for each grams/sec break point along the entire MAF calibration for the closed-loop points. Now you can take the information in the spreadsheet and use the first tab (labeled "Analysis") in order to help determine how you should modify your MAF calibration based on this accumulated data. Each tab of recorded MAF Batch datalogs can be used to get a greater average of what changes can be made to your MAF calibration table.

This part is fairly straight forward, if you see that the average STFT value for 3.00-3.99 is -9.2%, then you will want to go to the MAF calibration table and highlight the cells that have MAF Airflow values between 3.00-3.99, then press the M key which allows a multiplier value to be applied. The multiplier for this situation would be .908 (1 - .092), this will apply a 9.2% reduction to the value in these cells. This adjustment will now tell your ECU for that particular MAF voltage you now have 9.2% less MASS of air entering the engine so 9.2% less mass of fuel should be injected, bringing your fuel trims close to zero.

If that summation is +6% then you can highlight the MAF Calibration cell for that particular MAF Airflow and hit the “M” key, you will then be prompted to enter a floating point value. The correct value for this particular situation would be 1.06. This adjustment will now tell your ECU for that particular MAF voltage you now have a 6% greater MASS of air entering the engine so 6% more mass of fuel will be injected. After this adjustment is made and your ECU flashed with the map, your A/F Trims should be closer to zero. We suggest you shoot for a LTFT value of +/- 8% max.

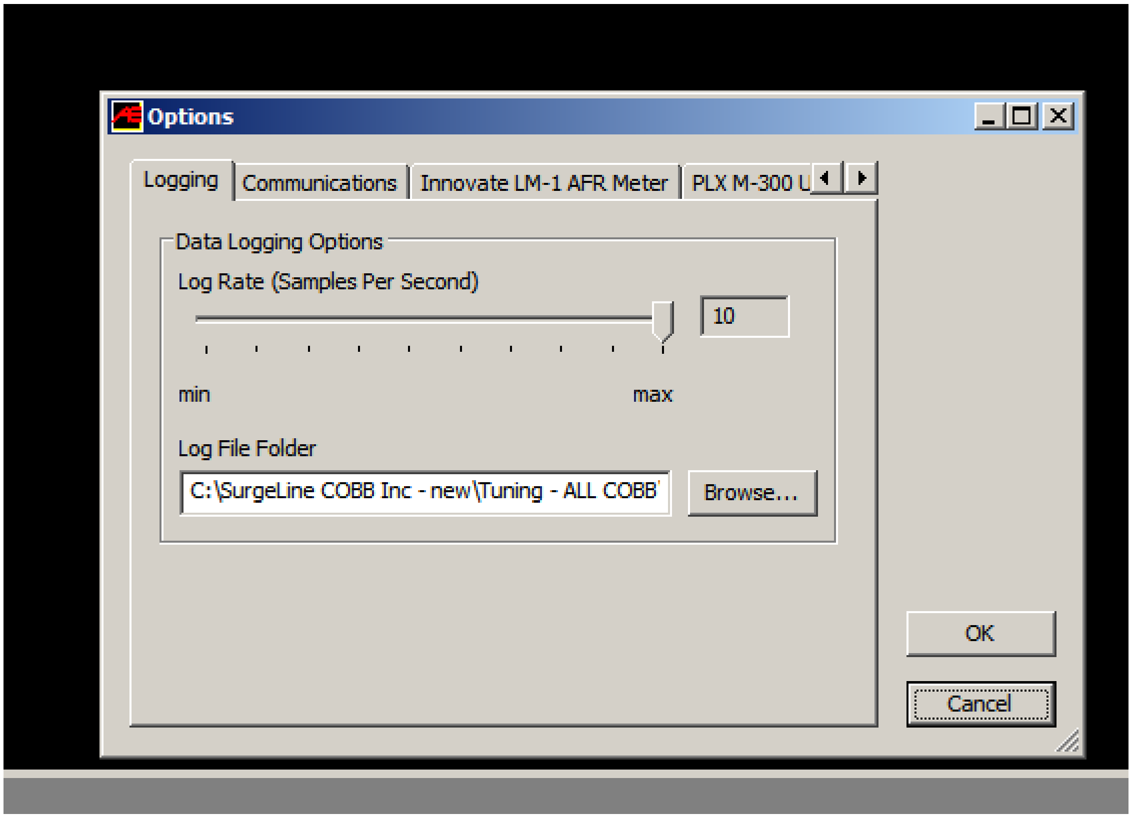
This worksheet also has a graph (similar to the one posted below) that we have created so you can better visualize the summary of this data.



This is just one model for data analysis. We may publish different models or different tuning techniques in future tuning guides.

B: Connect the AccessTUNER software to the AccessPORT equipped Civic Si and log critical engine parameters for testing.

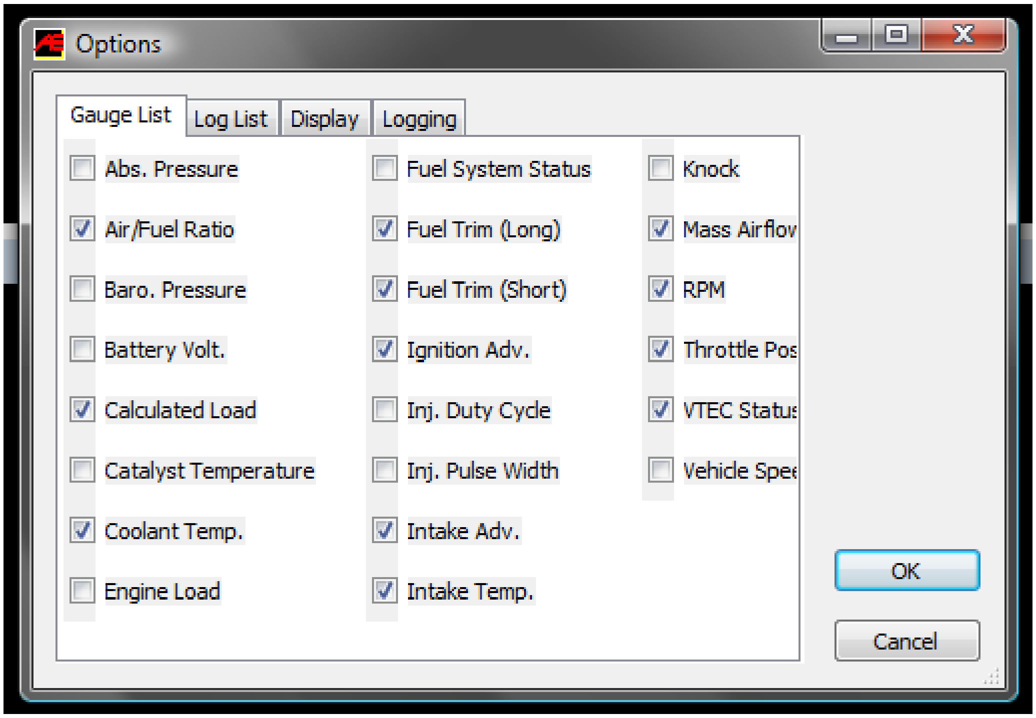
Open the selected starting point calibration in the AccessTUNER software. Configure the AccessTUNER software to connect to your vehicle. Attach the OBDII dongle to the vehicle and the associated USB cable to your computer. Press “Ctrl F” to configure the program. Select the directory in which to store your data logs in the “Logging” tab. Select the type of tuning cable and its associated com port in the “Communications” tab. You can also integrate a wideband O2 (WBO2) sensor signal into the data logs. Select the specific oxygen sensor you wish to use and indicate its associated com port. If you are trying to log external WBO2 serial information, you will need to attach the associated USB cable to your computer's other USB or serial port.



The AccessTUNER software allows the user to sample and record critical engine parameters. This data includes engine sensor information, commanded engine functions, and external WBO2 sensor serial information. With the vehicle ignition on, press "Ctrl L" to connect to the active ECU. Load the calibration currently flashed on to the ECU using your AccessPORT. If AccessTUNER is connected to the vehicle, the message in the lower right corner of the program will read "On-line". Press "Ctrl F" to configure the logged parameters and those displayed in the AccessTUNER "Dashboard". The dashboard is a screen that reports active engine parameters and sensor measurements. This screen is the single best way to assess the condition of the engine during tuning. It is critical to actively monitor parameters while tuning. These data allow the tuner to determine if a calibration is performing correctly. Accurate and deliberate assessment of logged parameters is the only way to avoid conditions that may damage the engine.

If more than 10 parameters are selected at any one time the rate of data collection may be lower than optimal. With 10 or fewer parameters the logging rate should be at a minimum of ~ 4 Hz.

Below is a list of logged parameters for the Civic Si. The selected parameters are those that are critical to record under most conditions. Other parameters may be selected or removed based upon the objectives of any specific tuning process.



Accel. Pedal Pos. (%) – Measurement of the Accelerator Pedal Position (APP) sensor (20 to 100%, 20% being normal APP signal for idle and 96% being full APP depression).

Actual AFR (AFR/Lambda) – Reporting of what the primary O2 sensor is measuring for Lambda or Air/Fuel Ratio. We do not suggest you use this sensor reading for performance tuning under WOT conditions.

Baro Press. (PSI/kPa) – Measurement of barometric pressure.

Battery Volt. (V) – Measurement of battery voltage.

Boost (PSI/kPa) – Relative manifold pressure (absolute pressure – barometric pressure).

Calculated Load (Load) – A calculated load value used by the ECU for look-up functions.

Catalyst Temp. (F/C) – Calculated temperature of catalytic converter.

Coolant Temp. (F/C) – Measurement of engine coolant temperature.

Fuel System (#) – Status of the fuel system.
1 = Open-loop due to insufficient engine temperature.
2 = Closed-loop, using O2 sensor feedback to determine fuel mixture.
3 = Open-loop due to engine load or fuel cut due to deceleration.
4 = Open-loop due to system failure.
5 = Closed-loop, using at least one O2 sensor but there is a fault in the feedback system.

Fuel Trim (Long) (%) – The ECU will control air fuel ratios at low loads with a closed-loop control system. This long term fuel trim (LTFT) indicates an average learned fuel correction needed to maintain the closed-loop fueling target.

Fuel Trim (Short) (%) – Immediate changes to commanded fuel to achieve a closed-loop fueling target under low load. An average STFT value will eventually translate to long term fuel trim.

Ignition Advance (deg) – Ignition timing in crankshaft degrees before (and after) top dead center. This is the final commanded ignition timing after all correction and adjustments.

Inj. Duty Cycle (%) – The calculated duty cycle the fuel injectors are currently running. The effective range is from 0-100%.

Inj. Pulse Width (ms) – The total open time of fuel injectors.

Intake Temp. (F/C) – Measurement of intake air temperature.

Intake Valve Adv. (deg) – Position of intake camshaft advance, in crankshaft degrees.

Knock (#) – Arbitrary value used to represent engine noise as heard by the knock sensor. Larger value spikes may indicate VTEC engagement or excessive engine noise, and the calibration may need to be made less aggressive.

MAP (PSI/kPa) – Absolute manifold pressure.

Mass Airflow (g/s) – Mass air flow sensor reading in grams per second of air flow.

RPM – Engine speed in revolutions per minute.

Throttle Position (%) – Percent of throttle opening (14 to 78%, 14% being normal throttle opening for idle and 78% being full throttle opening).

Vehicle Speed (mph/kph) – Vehicle speed calculated by using the output shaft (countershaft) speed sensor.

VTEC Status – Status of the VTEC system. 0 = OFF, or system is on the Low VTEC cam lobes, 1 = ON, or system is on the High VTEC cam lobes.

C: Tuning for appropriate High VTEC Engagement points and Camshaft Phasing settings.

Optimal High VTEC Engagement points are usually achieved when the car accelerates smoothly through the engagement points. Ideally, you can set High VTEC Engagement at every 100 RPM points then test the cross-over points to see which cross-over point produced the greatest average torque (area under the curve) for the entire engine RPM range at WOT. Please take into account that camshaft phasing will also need to be optimized in correlation with the different High VTEC Engagement points. This is a very time consuming process, but allows you to see what VTEC engagement RPM is ideal for the hardware combination you are running on your vehicle.

You have two different scenarios for High VTEC Engagement that you will want to avoid:

Scenario 1) If High VTEC Engagement is set too low in the RPM range, then the engine will likely loose a significant amount of torque for an extended RPM range. After this initial dip, torque will slowly increase as engine RPM increases. This is telling you that High VTEC Engagement is likely set too low in the RPM range. The vehicle will likely accelerate slower overall because the engine could achieve more torque (on average) throughout the RPM range if High VTEC Engagement were to occur later in the RPM range.

Scenario 2) If High VTEC Engagement is set too high in the RPM range, then the engine torque will steadily drop until High VTEC is engaged, then torque will likely jump significantly. This is telling you that High VTEC Engagement is likely set too high in the RPM range and will cause an abrupt or interrupted torque delivery. The vehicle will likely accelerate slower overall because the engine could achieve more torque (on average) if High VTEC Engagement were to occur earlier in the RPM range.

Four different variable camshaft tables are used for intake camshaft phasing control under either Low VTEC or High VTEC, and light throttle (closed-loop) or wide open throttle (open-loop) conditions. The Cobb OTS maps are designed with optimized camshaft phasing for fuel economy at light throttle optimum performance at WOT. Considerable effort was expended to optimize these calibrations for the Stage1 and Stage2 calibrations. These maps can be adjusted considerably for FI applications.

Establishing optimal intake camshaft phasing settings uses a very similar dyno testing process to setting optimal High VTEC Engagement points. Ideally, you want to use intake camshaft phasing settings to allow the engine to achieve as much volumetric efficiency as possible for every RPM point, across the entire RPM range. To find which settings work while dyno testing, you can make four different maps that will allow you to test four different intake camshaft phasing settings, 0 degrees, 15 degrees, 30 degrees, and 45 degrees intake camshaft advance. Please be sure to properly test each map on the chassis dyno and label the dyno runs accordingly. You can then overlay the different dyno graphs to see what intake camshaft advance settings produced the greatest average torque (area under the curve) for each specific RPM ranges. Then you can set your intake camshaft phasing for WOT accordingly based on your dyno testing results. Some data smoothing may be necessary. Once you believe you have optimal intake camshaft phasing settings, please be sure to dyno test and verify these tables settings.

At this point in time, you can take the WOT camshaft phasing tables and make two new maps that have +5 degrees intake camshaft advance and -5 degrees intake camshaft advance settings to see if any additional gains are to be had. Please take into account that High VTEC Engagement will also need to be optimized in correlation with the different intake camshaft phasing settings. This is a very time consuming process, but allows you to see what VTEC engagement RPM and intake camshaft phasing settings are ideal for the hardware combination you are running on your vehicle.

Precautions and Warnings

1) If you data log slightly different intake camshaft advance from what you've tuned for in the table, this is typically normal. However if your data logs show large disparities between the commanded intake camshaft advance shown in these tables and what you are data logging, this potentially means you have a mechanical issue with the hydraulic oil pressure control system.

2) The system has safe guards to prevent valve-to-piston interference ONLY when using stock pistons designed for the cylinder heads used and stock valvetrain including stock camshafts. If you are using after market pistons or camshafts, you are advised to contact the supplier as to the safe amount of intake camshaft advance you may run.

3) If you increase the intake camshaft advance values and the data you are logging does not increase, this may mean you have reached a designed mechanical limitation. The camshaft advancing mechanism may

simply not be able to increase intake camshaft phasing beyond a mechanically limited point, this is by design.

D: Fuel Tuning

The ideal air to fuel ratio (AFR) depends upon fuel quality. Higher octane fuels are more detonation resistant and therefore can be run at leaner A/F ratios. Leaner A/F ratios produce higher power but also create more heat. Excessive heat which can lead to premature ignition, or detonation. Lower octane fuels such as 91 and ACN91 (Arizona, California and Nevada 91 octane) are more prone to detonation and therefor require a richer A/F ratio. Rich A/F ratio combustion produces less heat and therefore less detonation. We have found that the Civic Si engine can run mid 13 to low 13 A/F ratios when running quality fuels. Lower quality fuels require high to mid 12 A/F ratios.

A Fuel mixture that is too lean will contribute to uncontrolled combustion, excessive heat, detonation and possible engine damage. The objective is to run the car at the richest A/F mixture possible that does not sacrifice power. Ultimately, the best A/F ratio can only be determined in concert with changes to ignition timing, High VTEC engagement, and camshaft phasing. For example, some cases a comparatively rich A/F mixture can be run with more ignition timing than a leaner mixture. This combination may produce higher power than a lean mixture with less ignition timing. Generally speaking, the A/F and ignition timing combination that produces the best power while minimizing heat is the desired calibration. Of course this ideal is not limited to ignition timing and fuel but is also a balance of variable cam phasing and, of course, High VTEC engagement.

The values in this table are critical to engine performance. The values indicated in the lower load regions are used as targets under closed-loop fuel control. In other words, these values are actively targeted by the ECU using feedback from the front oxygen sensor (which can be datalogged as Actual AFR). If the MAF is calibrated correctly then the corrections used to target low load fuel mixtures will be small (typically + or – 8% or closer to zero). Under higher load the ECU will switch from closed-loop fueling to an open loop strategy. The transition from closed to open-loop fueling usually occurs at ~4800 RPM under normal conditions, or at High VTEC engagement if High VTEC engagement is set below this RPM. If the MAF curve is properly calibrated then the fuel trims will be closer to zero under all conditions. A large difference in the fuel trims indicates that the MAF calibration is incorrect.

Precautions and Warnings – Overly lean fuel mixtures under can quickly damage the engine and other components. Always monitor Lambda or Air Fuel ratios using an external, professional Lambda meter when performing calibrations. If you are unsure of what kinds of fuel mixtures to target please examine stock calibrations and Cobb Tuning OTS calibrations for guidance (can be found here). Please be sure to replace your primary oxygen sensor if any signs of sensor inaccuracy or wear are present.

Every engine and every kind of fuel may indicate a different fuel ratio. However, most NA Honda applications utilize a leaner mixture of fuel to air when under high load. Depending upon fuel quality a normal “WOT” fuel mixture may be mid 13s (0.92 to 0.89 lambda) to mid 12s (0.88 to 0.85 lambda). Under more moderate load conditions, fuel ratios can be run much leaner. Most FI Honda applications utilize a richer mixture of fuel to air when under high load. Depending upon fuel quality a normal “WOT, on boost” fuel mixture may be mid 12s (0.88 to 0.85 lambda) to low 11s (0.79 to 0.75 lambda). Under more moderate load conditions, fuel ratios can be run much leaner. Supercharged applications will likely need a slightly richer fuel curve than a turbocharged application due to the increased intake air temperatures realized with this application due to a lack of an intercooler.

E: Ignition Advance Tuning

The Knock Sensitivity tables are calibrated well for engines running 89-91 octane fuel. If you see that the engine is running less ignition advance than desired and you are confident that the engine can withstand increased engine noise, then you can simply increase the values in these tables until the ECU's ability to respond to engine noise is lessened. If you see that the engine is running too much ignition advance or is exceeding MBT, then you can decrease the values in these tables until the ECU's ability to respond to engine noise is increased. You can also simply remove ignition advance from the primary ignition look-up tables.

To tune the ignition advance curve for WOT, you should run a excessively rich fuel curve (something around Lambda of 0.81 or a low 12:1 AFR Petrol) for a normally aspirated engine. You will need to datalog the following variables: RPM, Ignition Timing, Throttle Position, Knock Retard, Engine Load, and Actual AFR. For tuning of these we suggest you start of with less total ignition advance than is optimal, that way you can work your way up from there. Generally speaking, a Honda K-Series engine will run a relatively flat timing curve. This trend is normal for most internal combustion spark ignition Honda engines; as VE (Volumetric Efficiency) increases the amount of ignition advance a engine needs will decrease. As you cruise a engine's VE will not be the highest on an engine because the engine is not ingesting much air under cruise conditions so ignition advance will usually be higher. As VE increases at WOT (when the engine is ingesting as much air as possible) ignition advance will go down to a lower point until the VTEC cross-over when torque increases slightly then it will maintain a relatively flat ignition advance curve during the torque plateau. Once torque begins to fall off you will see ignition advance increase at higher RPM. This is due to the decreasing VE and is also done in order to keep up with the increasing piston speeds; you have to start the burn earlier so that the pressure wave expansion occurs at the optimal time.

We have found that one must have a chassis dyno to help find the thresholds for maximum ignition advance for a particular engine and the fuel that is being used. The following section should give you a much better understanding as to how the factory ignition system works and what you are trying to do by tuning your ignition advance curve. The objective of ignition tuning is very simple. You are trying to start the flame front, BEFORE Top-Dead-Center (TDC), so that the peak of the combustion chamber pressure wave pushes down on the piston AFTER TDC at the same time. This is why values in the ignition advance tables are in degrees of ignition advance BTDC. We must first go over how the ECU calculates total ignition advance before we can attempt to tune the ignition advance curve:

Total Ignition Advance =

The ECU will look-up the p**rimary ignition table value** for the corresponding RPM and Calculated Engine Load breakpoint for the camshaft advance that is being run then,

- removes **Knock Response adjustments made by ECU within the Knock Detection range**. Within the Knock Detection range, the ECU can make a final adjustment to remove ignition advance is it hears the engine noise is getting too close to the threshold, as determined by the corresponding Knock Sensitivity table settings. The ECU will do what it can to protect the engine.

With the above said, what you will be trying to do is get the total ignition advance curve as close to optimal for your engine and the fuel you are using. If your ECU and engine are happy with your calibration you will generally see that your knock response stays at less than 2 during most WOT runs.

You should be satisfied with the ignition advance curve if, while at WOT for several runs, hot ones even, the knock response stays less than 2 degrees across the RPM range and the ignition is a smooth predictable curve. This is not the only way to tune, just another perspective. You can sometimes try to allow more ignition advance so that the ECU will show me if the engine will make any additional torque with additional ignition advance. You can increase the total ignition advance in small increments, .5 - 1 degrees of ignition advance. Once you are able to find the optimal ignition advance curve your engine wants for the particular fuel you are using you should see that your total ignition advance curve is consistent.

Generally speaking, ignition advance is used to increase the volumetric efficiency (VE) of an engine where the efficiency does not naturally exist. With this said, peak VE is found at peak torque so the engine will likely need the least amount of ignition advance under these conditions. Please take into account that additional ignition advance is used as RPM increases, this is done to keep up with the every increasing piston speeds. You will typically need to increase ignition advance in order to keep up with the increasing piston speeds the engine will see as RPM increase. Once you exceed MBT (Minimum spark advance for Best Torque output), it is possible to make less power with more ignition advance. This is when tuning on a load based chassis dynamometer can be very beneficial.

Precautions and Warnings – We cannot stress how important it is to properly populate the ignition advance tables for the various camshaft phasing so the interpolation/transition between the tables is smooth. The car may drive poorly if the table settings are too far apart. The Honda ECU will interpolate values between various tables as intake camshaft advance slightly moves around the target camshaft advance due to oil pressure fluctuations and large table setting variances may create driving quality issues.

This ECU will constantly try to run more ignition advance than is necessary at part throttle conditions. It does this in order to allow the ECU to detect MBT for each individual vehicle. Once the ECU exceeds MBT, the ECU will remove excess ignition advance through the knock response function. This is normal and should not concern you, cylinder pressures at part throttle are not high enough to cause any damage. If consistent knock response is calculated or audible detonation is present, you are welcome to remove ignition advance during part throttle conditions, although your fuel economy may go down during these conditions.

F: Integrating all tuning parameters for the ideal calibration

The ideal calibration for your Civic Si is a combination of all major tuning areas outlined above. Generally speaking, the Civic Si will make the most power when run lean with the maximal amount of ignition timing that the ECU will allow without detonating. However, this ideal AFR of 13.6:1 A/F ratio and high ignition timing is not realistic for all configurations and fuels. The only way to determine if a calibration is ideal is to run the car on a chassis dynamometer where the impact of calibration changes are easily measured. For example, addition of ignition timing that does not result in increased torque is a not ideal. If additional timing does not create power then you are simply adding stress to the engine components without tangible benefit. The same is true of camshaft phasing and A/F ratios. If you can run the vehicle at a richer A/F ratio without losing power this is more ideal than running the car lean. On FI applications, if increasing boost does not yield considerable power gains, the turbo may simply be out of its efficiency range. In this scenario less boost is actually more power. To get a course idea of how the ideal tune looks on your fuel type and mechanical configuration, examine the Cobb OTS map notes.

G: Precautions:

Boost – Tuning forced induction applications improperly can more quickly damage an engine. Forced induction applications create enough cylinder pressure to cause engine damage. Be cautious when adjusting boost control parameters. Be particularly cautious when any mechanical component of the boost control system is altered.

Fuel – The stock fuel injectors are ~320cc and the stock fuel system is a return-less fuel system. These vehicles can create enough airflow to drive these injectors at or above their maximal capacity with properly designed bolt-on performance hardware. This is particularly true for vehicles equipped with high flow exhaust systems and forced induction applications. Be cautious about running out of injector on similarly equipped vehicles.

AccessTUNER Program shortcuts:

Ctrl L – Initiate live tuning, connect to or disconnect from a the ECU
Ctrl F – Configure Program
- when Offline configures communication settings and WBO2 integration
- when Online configures logged parameters for dashboard and saved data logs

Ctrl D – Initiate and terminate data log
Ctrl T – Initiate or terminate live tracing in tables
Ctrl Alt S – Save AccessTUNER Pro calibration
Ctrl Alt A – Save AccessTUNER Race calibration
Ctrl Alt O – Open AccessTUNER Pro calibrations
Ctrl Alt E – Open AccessTUNER Race calibrations
Ctrl A – Open advanced calibration settings – activate or deactivate Check Engine Lights (CEL)
Ctrl G – Change ECU
Ctrl K – Revert to stock calibration

Table editing shortcuts:
E – Direct edit
H – Horizontal interpolation of selected tables
V – Vertical interpolation of selected Tables
M – Multiplication of selected tables by factor of x

Note: This is a list of tables available on all Honda AccessTUNER products. Not all tables are available in your software.

Breakpoint Adjustment Tables

The Honda Breakpoint adjustment tables apply to Camshaft Phasing, Fueling, Ignition, & Knock Sensitivity tables differently. In order to see these changes take effect in the software, you will first need to save the map, then re-load the map or use the Revert to Working Map (Ctrl+I) function. After this is done, you should be able to see the changed breakpoint settings on the various tables. With forced induction tuning, please understand that you have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint A High VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for open-loop, high VTEC tables.

Tuning Tips – You can use these table to adjust high VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint A Low VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for closed-loop, low VTEC tables.

Tuning Tips – You can use these table to adjust low VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint B High VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for open-loop, high VTEC tables.

Tuning Tips – You can use these table to adjust high VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint B Low VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for closed-loop, low VTEC tables.

Tuning Tips – You can use these table to adjust low VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint C High VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for open-loop, high VTEC tables.

Tuning Tips – You can use these table to adjust high VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint C Low VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for closed-loop, low VTEC tables.

Tuning Tips – You can use these table to adjust low VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint D High VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for open-loop, high VTEC tables.

Tuning Tips – You can use these table to adjust high VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint D Low VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for closed-loop, low VTEC tables.

Tuning Tips – You can use these table to adjust low VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint E High VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for open-loop, high VTEC tables.

Tuning Tips – You can use these table to adjust high VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Camshaft Advance Breakpoint E Low VTEC

Table Description – This table will allow you to adjust the camshaft advance breakpoints for closed-loop, low VTEC tables.

Tuning Tips – You can use these table to adjust low VTEC camshaft advance breakpoints appropriately.

Precautions and Warnings – You have a fixed number of camshaft advance breakpoints so please make sure you keep resolution where need be.

Load Breakpoint Adj. - CL Camshaft Phasing

Table Description – This table will allow you to adjust the load breakpoints for Closed-Loop Camshaft Phasing tables.

Tuning Tips – You can use these table to adjust RPM breakpoints appropriately.

Precautions and Warnings – You have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be. You will need to save the map, then re-load the map in order to see these changes take effect in the various tables.

Load Breakpoint Adj. - Fuel, Ign., and Knock Sens.

Table Description – This table will allow you to adjust the load breakpoints for Fueling, Ignition, and Knock Sensitivity tables.

Tuning Tips – You can use these table to adjust RPM breakpoints appropriately.

Precautions and Warnings – You have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be. You will need to save the map, then re-load the map in order to see these changes take effect in the various tables.

RPM Breakpoint Adj. - CL/Low VTEC Fuel, Ign., and Knock Sens.

Table Description – This table will allow you to adjust the RPM breakpoints for Closed-Loop/Low VTEC Fueling, Ignition, and Knock Sensitivity tables.

Tuning Tips – You can use these table to adjust RPM breakpoints appropriately.

Precautions and Warnings – You have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be. You will need to save the map, then re-load the map in order to see these changes take effect in the various tables.

RPM Breakpoint Adj. - Intake Cam Phasing CL/High VTEC

Table Description – This table will allow you to adjust the RPM breakpoints for Closed-Loop/High VTEC Camshaft Phasing table.

Tuning Tips – You can use these table to adjust camshaft phasing so the phasing is where desired at the appropriate High VTEC Engagement RPM. These tables should not need to be adjusted when controlling a normally aspirated engine.

Precautions and Warnings – You have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be. You will need to save the map, then re-load the map in order to see these changes take effect in the various tables.

RPM Breakpoint Adj. - Intake Cam Phasing CL/Low VTEC

Table Description – This table will allow you to adjust the RPM breakpoints for Closed-Loop/Low VTEC Camshaft Phasing table.

Tuning Tips – You can use these table to adjust RPM breakpoints appropriately.

Precautions and Warnings – You have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be. You will need to save the map, then re-load the map in order to see these changes take effect in the various tables.

RPM Breakpoint Adj. - Intake Cam Phasing OL/High VTEC

Table Description – This table will allow you to adjust the load breakpoints for Open Loop/High VTEC Camshaft Phasing table.

Tuning Tips – You can use these table to adjust RPM breakpoints appropriately.

Precautions and Warnings – You have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be. You will need to save the map, then re-load the map in order to see these changes take effect in the various tables.

RPM Breakpoint Adj. - Intake Cam Phasing OL/Low VTEC

Table Description – This table will allow you to adjust the load breakpoints for Open Loop/Low VTEC Camshaft Phasing tables.

Tuning Tips – You can use these table to adjust RPM breakpoints appropriately.

Precautions and Warnings – You have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be. You will need to save the map, then re-load the map in order to see these changes take effect in the various tables.

RPM Breakpoint Adj. - OL/High VTEC Fuel, Ign., Knock Sens.

Table Description – This table will allow you to adjust the RPM breakpoints for Open Loop/High VTEC Fueling, Ignition, and Knock Sensitivity tables.

Precautions and Warnings – You have a fixed number of load and RPM breakpoints so please make sure you keep resolution where need be. You will need to save the map, then re-load the map in order to see these changes take effect in the various tables.

Camshaft Phasing Tables

The Honda Fueling and Ignition look-up functions depend on the camshaft phasing that is being run and whether the car is using the Low Cam or High Cam VTEC profiles.

Intake Cam Phasing CL/Low VTEC

Intake Cam Phasing CL/High VTEC

Intake Cam Phasing OL/Low VTEC

Intake Cam Phasing OL/High VTEC

Intake Cam Advance is a variable camshaft phasing control technology used by Honda. Hydraulic oil pressure is used to advance the intake camshaft phasing in an effort to optimize power through the entire engine speed and load ranges.

Table Description – This table represent the amount of intake camshaft advance represented in camshaft degrees. The table is referenced by Engine Speed on the x-axis and by Calculated Engine Load on the y-axis. Table values are the degrees of camshaft phasing advance (shown in camshaft degrees) that the variable valve timing system will attempt to target. Higher values mean more advance, lower values mean less advance. You cannot retard (use a value less than zero) the intake camshaft. This is a closed-loop system and will make attempts to compensate for differences in oil pressure, temperature, oil viscosity, etc. As the system is hydraulically controlled by engine oil, changes may not occur instantaneously.

Tuning Tips – Tuning these tables takes patience and the ability to accurately quantify if changes are resulting in improvements or not. Depending on your level of modification, there are appreciable gains to be made through intake camshaft advance tuning. Partial throttle (ie: not full load, WOT) gains can be significant as well, provided you have the equipment (load bearing dyno) capable of accurately quantifying any gains from these changes. It is ultimately your responsibility to understand in more precise details about what setting work best for your hardware combination. This is part of the job of tuning. Keep in mind that the engine is an air pump and functions as a system. Changes in your intake camshaft advance tuning can result in changes in your measured A/F Ratio, fuel consumption, optimal ignition advance, torque output, etc.

Precautions and Warnings

1) If you data log slightly different intake camshaft advance from what you've tuned for in the table, this is typically normal. However if your data logs show large disparities between the commanded intake camshaft advance shown in these tables and what you are data logging, this potentially means you have a mechanical issue with the hydraulic oil pressure control system.
2) The system has safe guards to prevent valve-to-piston interference ONLY when using stock pistons designed for the cylinder heads used and stock valvetrain including stock camshafts. If you are using after market pistons or camshafts, you are advised to contact the supplier as to the safe amount of intake camshaft advance you may run.
3) If you increase the intake camshaft advance values and the data you are logging does not increase, this may mean you have reached a designed mechanical limitation. The camshaft advancing mechanism may simply not be able to increase intake camshaft phasing beyond a mechanically limited point, this is by design.

Max Allowed VTC

Table Description – This table represent the maximum amount of intake camshaft advance that the ECM will allow to be targeted. These settings are effectively ceilings that dictate the maximum amount of intake camshaft advance that can be run. Higher values mean more advance, lower values mean less advance. You cannot retard (use a value less than zero) the intake camshaft, maximum retard is achieved at 0 degrees of advance. Camshaft phasing control is a closed-loop system and will make attempts to compensate for differences in oil pressure, temperature, oil viscosity, etc. As the system is hydraulically controlled by engine oil, changes may not occur instantaneously.

Tuning Tips – Please take into account that you do not want to run too much intake camshaft advance. Too much intake camshaft advance can create valve-to-valve and valve-to-piston clearance issues which will quickly destroy an engine. Depending on your level of modification, there are appreciable gains to be made through intake camshaft advance tuning. Partial throttle (ie: not full load, WOT) gains can be significant as well, provided you have the equipment (load bearing dyno) capable of accurately quantifying any gains from these changes. It is ultimately your responsibility to understand in more precise details about what setting work best for your hardware combination. This is part of the job of tuning. Keep in mind that the engine is an air pump and functions as a system. Changes in your intake camshaft advance tuning can result in changes in your measured A/F Ratio, fuel consumption, optimal ignition advance, torque output, etc.

Precautions and Warnings
1) If you data log slightly different intake camshaft advance from what you've tuned for in the table, this is typically normal. However if your data logs show large disparities between the commanded intake camshaft advance shown in these tables and what you are data logging, this potentially means you have a mechanical issue with the hydraulic oil pressure control system.
2) The system has safe guards to prevent valve-to-piston interference ONLY when using stock pistons designed for the cylinder heads used and stock valvetrain including stock camshafts. If you are using after market pistons or camshafts, you are advised to contact the supplier as to the safe amount of intake camshaft advance you may run.
3) If you increase the intake camshaft advance values and the data you are logging does not increase, this may mean you have reached a designed mechanical limitation. The camshaft advancing mechanism may simply not be able to increase intake camshaft phasing beyond a mechanically limited point, this is by design.

Max Allowed VTC MIL Detection Limit

Table Description – This table tells the ECU the camshaft phasing point at which it should recognize MIL P1009 (Variable Valve Timing Control (VTC) Advance Malfunction). If the variable camshaft phasing values go above this limit then the ECU will detect something is wrong with the camshaft phasing controls and will detect MIL P1009.

Tuning Tips – Set appropriately.

Precautions and Warnings – None at this time.

Fuel Tables

Fuel Cylinder 1 Comp.

Fuel Cylinder 2 Comp.

Fuel Cylinder 3 Comp.

Fuel Cylinder 4 Comp.

Table Description – These are compensatory tables used to modify fueling delivery to each cylinder. Negative values would decrease fueling to that particular cylinder, positive values would increase fueling to that particular cylinder.

Tuning Tips – Cylinder 1 is the cylinder closest to the timing chain, cylinder 4 is the cylinder furthest from the timing chain. Using individual EGT sensors is usually the most effective means of determining what cylinders may require more or less fuel.

Precautions and Warnings – Overly lean fuel mixtures under full loads can quickly damage the engine and other components. Always monitor Lambda or Air Fuel ratios using an external, professional Lambda meter when performing calibrations. If you are unsure of what kinds of fuel mixtures to target please examine stock calibrations and Cobb Tuning OTS calibrations for guidance (can be found here). Please be sure to replace your primary oxygen sensor if any signs of sensor inaccuracy or wear are present.

Every engine and every kind of fuel may indicate a different fuel ratio. However, most NA Honda applications utilize a leaner mixture of fuel to air when under high load. Depending upon fuel quality a normal “WOT” fuel mixture may be mid 13s (0.92 to 0.89 lambda) to mid 12s (0.88 to 0.85 lambda). Under more moderate load conditions, fuel ratios can be run much leaner. Most FI Honda applications utilize a richer mixture of fuel to air when under high load. Depending upon fuel quality a normal “WOT, on boost” fuel mixture may be mid 12s (0.88 to 0.85 lambda) to low 11s (0.79 to 0.75 lambda). Under more moderate load conditions, fuel ratios can be run much leaner. Supercharged applications will likely need a slightly richer fuel curve than a turbocharged application due to the increased intake air temperatures realized with this application due to a lack of an intercooler.

Fuel Multiplier Fixed

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

Fuel Multiplier by RPM

Table Description – This is a single dimensional table that references RPM to increase fueling based on a multiplier. If the values are decreased, the engine will run leaner. If the values are increased, the engine will run richer.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

Fueling Low VTEC Primary A

Fueling Low VTEC Primary B

Fueling Low VTEC Secondary

Fueling High VTEC Primary A

Fueling High VTEC Primary B

Fueling High VTEC Secondary

Table Description – These are 3-dimensional tables defined by engine RPM on the horizontal axis and Calculated Engine Load on the vertical axis. The numbers in the table are in Air/Fuel ratios or Lambda that the ECU will try to target during closed-loop (CL) and open-loop (OL) conditions. Higher values represent a leaner fuel curve, lower values represent a richer fuel curve.

Tuning Tips – The values in this table are critical to engine performance. The values indicated in the lower load regions are used as targets under closed-loop fuel control. In other words, these values are actively targeted by the ECU using feedback from the front oxygen sensor (which can be datalogged as Actual AFR). If the MAF is calibrated correctly then the corrections used to target low load fuel mixtures will be small (typically + or – 8% or closer to zero). Under higher load the ECU will switch from closed-loop fueling to an open loop strategy. The transition from closed to open-loop fueling usually occurs at ~4800 RPM under normal conditions, or at High VTEC engagement if High VTEC engagement is set below this RPM. If the MAF curve is properly calibrated then the fuel trims will be closer to zero under all conditions. A large difference in the fuel trims indicates that the MAF calibration is incorrect.

Precautions and Warnings – Overly lean fuel mixtures under full loads can quickly damage the engine and other components. Always monitor Lambda or Air Fuel ratios using an external, professional Lambda meter when performing calibrations. If you are unsure of what kinds of fuel mixtures to target please examine stock calibrations and Cobb Tuning OTS calibrations for guidance (can be found here). Please be sure to replace your primary oxygen sensor if any signs of sensor inaccuracy or wear are present.

Every engine and every kind of fuel may indicate a different fuel ratio. However, most NA Honda applications utilize a leaner mixture of fuel to air when under high load. Depending upon fuel quality a normal "WOT" fuel mixture may be mid 13s (0.92 to 0.89 lambda) to mid 12s (0.88 to 0.85 lambda). Under more moderate load conditions, fuel ratios can be run much leaner. Most FI Honda applications utilize a richer mixture of fuel to air when under high load. Depending upon fuel quality a normal "WOT, on boost" fuel mixture may be mid 12s (0.88 to 0.85 lambda) to low 11s (0.79 to 0.75 lambda). Under more moderate load conditions, fuel ratios can be run much leaner. Supercharged applications will likely need a slightly richer fuel curve than a turbocharged application due to the increased intake air temperatures realized with this application due to a lack of an intercooler.

Idle Tables

Idle Target RPM

Idle Target RPM Initial

Table Description – A single row of target idle speeds that vary as a function of engine coolant temperature. The ECU will generally use the Idle Target RPM Initial values when loads switches on or off (A/C Compressor, etc.), then the ECU will move the idle speeds up to the Idle Target RPM values and maintain a stable idle at those points.

Tuning Tips – Vehicles with stock camshafts and other engine components should idle at stock levels. Some larger camshafts, and or/fuel injectors, lightweight pulleys, lightweight flywheels, may require a higher target idle for stable operation. When running significantly larger fuel injectors we have found it has been helpful to maintain an Idle Speed which is 100-400 RPM higher than the factory calibration. At idle, the vehicle is in closed-loop operation trying to maintain 1 Lambda or an AFR Petrol of 14.68:1 and the ECU might modify the injector pulse width (IPW) to a point where the ECU will not allow a fuel injector to fully open and close due to the short pulse width is running in order to his this fuel target. Larger fuel injectors need a minimum injector pulse width in order to fully open and close; if the engine is idling too low then the pulse width is too short to allow the injector to work properly and an occasional miss-fire can occur.

If your idle RPM or AFR at idle has a slight fluctuation then you may need to modify your intake calibration table settings around the MAF voltage the vehicle idles. We have found that the stock calibration settings at idle can be too far apart and they may need to be adjusted so they are closer together at the MAF Airflow where the vehicle idles. For this example we will say that the vehicle is idling around 2-4 grams/sec MAF Airflow.

Ignition Tables

The Honda Fueling and Ignition look-up functions depend on the camshaft phasing that is being run and whether VTEC is on the low camshaft or high camshaft profiles.

Ign Adv CL/Low VTEC @ A Cam Advance

Ign Adv CL/Low VTEC @ B Cam Advance

Ign Adv CL/Low VTEC @ C Cam Advance

Ign Adv CL/Low VTEC @ D Cam Advance

Ign Adv CL/Low VTEC @ E Cam Advance

Table Descriptions – These tables are all 3-dimensional and defined by engine RPM on the horizontal axis and Calculated Engine Load on the vertical axis. The numbers in the table represent the rotational angle in degrees before top dead center that the coil is fired in each cylinder's combustion cycle for the given camshaft advance while the engine is in Low VTEC (or while High VTEC is not engaged).

Tuning Tips – To tune the ignition advance curve for WOT, you should run a excessively rich fuel curve (something around Lambda of 0.81 or a low 12:1 AFR Petrol) for a normally aspirated engine. You will need to datalog the following variables: RPM, Ignition Timing, Throttle Position, Knock Retard, Engine Load, and Actual AFR. For tuning of these we suggest you start of with less total ignition advance than is optimal, that way you can work your way up from there. Generally speaking, a Honda K-Series engine will run a relatively flat timing curve. This trend is normal for most internal combustion spark ignition Honda engines; as VE (Volumetric Efficiency) increases the amount of ignition advance a engine needs will decrease. As you cruise a engine's VE will not be the highest on an engine because the engine is not ingesting much air under cruise conditions so ignition advance will usually be higher. As VE increases at WOT (when the engine is ingesting as much air as possible) ignition advance will go down to a lower point until the VTEC cross-over when torque increases slightly then it will maintain a relatively flat ignition advance curve during the torque plateau. Once torque begins to fall off you will see ignition advance increase at higher RPM. This is due to the decreasing VE and is also done in order to keep up with the increasing piston speeds; you have to start the burn earlier so that the pressure wave expansion occurs at the optimal time.

We have found that one must have a chassis dyno to help find the thresholds for maximum ignition advance for a particular engine and the fuel that is being used. The following section should give you a much better understanding as to how the factory ignition system works and what you are trying to do by tuning your ignition advance curve. The objective of ignition tuning is very simple. You are trying to start the flame front, BEFORE Top-Dead-Center (TDC), so that the peak of the combustion chamber pressure wave pushes down on the piston AFTER TDC at the same time. This is why values in the ignition advance tables are in degrees of ignition advance BTDC. We must first go over how the ECU calculates total ignition advance before we can attempt to tune the ignition advance curve:

Total Ignition Advance =

The ECU will look-up the p**rimary ignition table value** for the corresponding RPM and Calculated Engine Load breakpoint for the camshaft advance that is being run then,

- removes **Knock Response adjustments made by ECU within the Knock Detection range**. Within the Knock Detection range, the ECU can make a final adjustment to remove ignition advance is it hears the engine noise is getting too close to the threshold, as determined by the corresponding Knock Sensitivity table settings. The ECU will do what it can to protect the engine.

With the above said, what you will be trying to do is get the total ignition advance curve as close to optimal for your engine and the fuel you are using. If your ECU and engine are happy with your calibration you will generally see that your knock response stays at less than 2 during most WOT runs.

You should be satisfied with the ignition advance curve if, while at WOT for several runs, hot ones even, the knock response stays less than 2 degrees across the RPM range and the ignition is a smooth predictable curve. This is not the only way to tune, just another perspective. You can sometimes try to allow more ignition advance so that the ECU will show me if the engine will make any additional torque with additional ignition advance. You can increase the total ignition advance in small increments, .5 - 1 degrees of ignition advance. Once you are able to find the optimal ignition advance curve your engine wants for the particular fuel you are using you should see that your total ignition advance curve is consistent.

Generally speaking, ignition advance is used to increase the volumetric efficiency (VE) of an engine where the efficiency does not naturally exist. With this said, peak VE is found at peak torque so the engine will likely need the least amount of ignition advance under these conditions. Please take into account that additional ignition advance is used as RPM increases, this is done to keep up with the every increasing piston speeds. You will typically need to increase ignition advance in order to keep up with the increasing piston speeds the engine will see as RPM increase. Once you exceed MBT (Minimum spark advance for Best Torque output), it is possible to make less power with more ignition advance. This is when tuning on a load based chassis dynamometer can be very beneficial.

Precautions and Warnings – We cannot stress how important it is to properly populate the ignition advance tables for the various camshaft phasing so the interpolation/transition between the tables is smooth. The car may drive poorly if the table settings are too far apart. The Honda ECU will interpolate values between various tables as intake camshaft advance slightly moves around the target camshaft advance due to oil pressure fluctuations and large table setting variances may create driving quality issues.

This ECU will constantly try to run more ignition advance than is necessary at part throttle conditions. It does this in order to allow the ECU to detect MBT for each individual vehicle. Once the ECU exceeds MBT, the ECU will remove excess ignition advance through the knock response function. This is normal and should not concern you, cylinder pressures at part throttle are not high enough to cause any damage. If consistent knock response is calculated or audible detonation is present, you are welcome to remove ignition advance during part throttle conditions, although your fuel economy may go down during these conditions.

Ign Adv OL/High VTEC @ A Cam Advance

Ign Adv OL/High VTEC @ B Cam Advance

Ign Adv OL/High VTEC @ C Cam Advance

Ign Adv OL/High VTEC @ D Cam Advance

Ign Adv OL/High VTEC @ E Cam Advance

Table Descriptions – These tables are all 3-dimensional and defined by engine RPM on the horizontal axis and Calculated Engine Load on the vertical axis. The numbers in the table represent the rotational angle in degrees before top dead center that the coil is fired in each cylinder's combustion cycle for the given camshaft advance while the engine is in High VTEC (or while High VTEC is engaged).

Tuning Tips – These tables are calibrated well for engines running 89-91 octane fuel. If you see that the engine is running less ignition advance than desired and you are confident that the engine can withstand increased engine noise, then you can simply increase the values in these tables until the ECU's ability to respond to engine noise is lessened. If you see that the engine is running too much ignition advance or is exceeding MBT, then you can decrease the values in these tables until the ECU's ability to respond to engine noise is increased. You can also simply remove ignition advance from the primary ignition look-up tables.

To tune the ignition advance curve for WOT, you should run a excessively rich fuel curve (something around Lambda of 0.81 or a low 12:1 AFR Petrol) for a normally aspirated engine. You will need to datalog the following variables: RPM, Ignition Timing, Throttle Position, Knock Retard, Engine Load, and Actual AFR. For tuning of these we suggest you start of with less total ignition advance than is optimal, that way you can work your way up from there. Generally speaking, a Honda K-Series engine will run a relatively flat timing curve. This trend is normal for most internal combustion spark ignition Honda engines; as VE (Volumetric Efficiency) increases the amount of ignition advance a engine needs will decrease. As you cruise a engine’s VE will not be the highest on an engine because the engine is not ingesting much air under cruise conditions so ignition advance will usually be higher. As VE increases at WOT (when the engine is ingesting as much air as possible) ignition advance will go down to a lower point until the VTEC cross-over when torque increases slightly then it will maintain a relatively flat ignition advance curve during the torque plateau. Once torque begins to fall off you will see ignition advance increase at higher RPM. This is due to the decreasing VE and is also done in order to keep up with the increasing piston speeds; you have to start the burn earlier so that the pressure wave expansion occurs at the optimal time.

We have found that one must have a chassis dyno to help find the thresholds for maximum ignition advance for a particular engine and the fuel that is being used. The following section should give you a much better understanding as to how the factory ignition system works and what you are trying to do by tuning your ignition advance curve. The objective of ignition tuning is very simple. You are trying to start the flame front, BEFORE Top-Dead-Center (TDC), so that the peak of the combustion chamber pressure wave pushes down on the piston AFTER TDC at the same time. This is why values in the ignition advance tables are in degrees of ignition advance BTDC. We must first go over how the ECU calculates total ignition advance before we can attempt to tune the ignition advance curve:

Total Ignition Advance =

The ECU will look-up the p**rimary ignition table value** for the corresponding RPM and Calculated Engine Load breakpoint for the camshaft advance that is being run then,

- removes **Knock Response adjustments made by ECU within the Knock Detection range**. Within the Knock Detection range, the ECU can make a final adjustment to remove ignition advance is it hears the engine noise is getting too close to the threshold, as determined by the corresponding Knock Sensitivity table settings. The ECU will do what it can to protect the engine.

With the above said, what you will be trying to do is get the total ignition advance curve as close to optimal for your engine and the fuel you are using. If your ECU and engine are happy with your calibration you will generally see that your knock response stays at less than 2 during most WOT runs.

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Precautions and Warnings – We cannot stress how important it is to properly populate the ignition advance tables for the various camshaft phasing so the interpolation/transition between the tables is smooth. The car may drive poorly if the table settings are too far apart. The Honda ECU will interpolate values between various tables as intake camshaft advance slightly moves around the target camshaft advance due to oil pressure fluctuations and large table setting variances may create driving quality issues.

This ECU will constantly try to run more ignition advance than is necessary at part throttle conditions. It does this in order to allow the ECU to detect MBT for each individual vehicle. Once the ECU exceeds MBT, the ECU will remove excess ignition advance through the knock response function. This is normal and should not concern you, cylinder pressures at part throttle are not high enough to cause any damage. If consistent knock response is calculated or audible detonation is present, you are welcome to remove ignition advance during part throttle conditions, although your fuel economy may go down during these conditions.

Ign. Cylinder 1 Comp.

Ign. Cylinder 2 Comp.

Ign. Cylinder 3 Comp.

Ign. Cylinder 4 Comp.

Table Description – These are compensatory tables used to modify ignition calculations for each cylinder. Negative values would run less ignition advance to that particular cylinder, positive values would run more ignition advance to that particular cylinder.

Tuning Tips – Cylinder 1 is the cylinder closest to the timing chain, cylinder 4 is the cylinder furthest from the timing chain. Using individual EGT sensors is usually the most effective means of determining what cylinders may require more or less fuel.

Precautions and Warnings – Tune appropriately.

Ignition Coil Dwell Time

Table Description – The table contains latency values used to tell the ECU how much latency is needed to properly charge the ignition coils at differing battery voltage. This 2-dimensional look-up table indicates the desired ignition coil dwell in milliseconds (1000mS = 1 second). The values in the table represent the amount of ignition coil charge time under different battery voltage. All ignition coils require a certain amount of charge time before the full spark energy can be discharged, this is referred to as Ignition Dwell. This property may also be referred to as coil dead time or dwell time. The amount of latency a coil needs depends on the design of the coil and the spark energy necessary to ignite the combustion gases. Lower battery voltage will increase the coil's dwell (dead time). Likewise, higher battery voltage may reduce the charge time necessary. The factory ECU has ignition dwell adjustments based on battery voltage and engine RPM. The data in this table is represented in milliseconds; this is the only table that exists for the sole purpose of adjusting ignition coil dwell values.

Tuning Tips – Proper values in this table are critical for proper coil maintenance and operation. Ignition coils are temporary storages of spark energy and are discharge with every power cycle of the engine. The time it takes to charge a coil to full capacity will need to be calibrated if the coils are different from stock, and the charge time can vary tremendously across different brands and types of coils, as well as how much combustion pressure (manifold pressure) the coil has to ignite within. The coil charge time also depends upon the car's electrical system voltage. For properly operating stock coils this table does not need to be altered. Most ignition coil manufacturers will be able to provide you with this dwell data and the voltage they are referenced at. Use that as a starting point and modify from there. Don't be afraid if your final values differ from what the manufacturer provided. To tune this table, we suggest that you first establish a stable idle with the new coils.

One way to find the correct dwell (or at least the dwell that works best with the ignition drivers in the ECU and your particular coils) is to have your calibration running on a fuel curve that has proven to work well. You can then increase and decrease ignition dwell time to test what setting work best for your coil combination.

This is part of a calibration process that should be able to get you close to the ideal settings necessary to allow for proper ignition coil charge times. This will be necessary to match the characteristics of the ignition coils.

Precautions and Warnings – We suggest you do not run too much ignition dwell for this will prematurely wear the coils. Insufficient ignition dwell settings will discharge the coil with too little spark energy. The sputtering would sound much like operating the engine with a spark plug gap that is too large. These tables should not need to be adjusted when using stock ignition coils.

Max. Allowed Ignition Adv.

Table Description – This table represent the maximum amount of ignition advance that the ECU can run. This effectively is a ceilings that dictates the maximum amount of ignition advance that can be run. Higher values mean more total ignition advance, lower values mean less total ignition advance.

Tuning Tips – Set appropriately for the given conditions.

Precautions and Warnings – Tune appropriately.

Min. Allowed Ignition Adv. A

Min. Allowed Ignition Adv. B

Min. Allowed Ignition Adv. C

Min. Allowed Ignition Adv. D

Table Description – This table represent the minimum amount of ignition advance that the ECU can run. This effectively is a floor that dictates the minimum amount of ignition advance that can be run. Higher values mean more total ignition advance, lower values mean less total ignition advance.

Tuning Tips – Set appropriately for the given conditions. You may need to test to see what tables are being used for the different conditions or you can set all table to the same values.

Precautions and Warnings – Tune appropriately.

Injector Tables

Base Pulse Width

Table Description – This is a 2-dimensional table defined by engine RPM on the horizontal axis and contains a base pulse width for fuel injection calculations. This table can be effectively used as an injector scaler for controlling different size fuel injectors or for running significantly different fuels, like E85. The numbers in the table are base fuel injector pulse width values used in calculating closed-loop (CL) and open-loop (OL) fueling.

Tuning Tips – Lower values would be used for controlling larger fuel injectors, higher values for smaller fuel injectors or for fuels (with qualities similar to E85) that require additional fuel mass to achieve stoichiometry.

Precautions and Warnings – Overly lean fuel mixtures under can quickly damage the engine and other components. Always monitor Lambda or Air Fuel ratios using an external, professional Lambda meter when performing calibrations. If you are unsure of what kinds of fuel mixtures to target please examine stock calibrations and Cobb Tuning OTS calibrations for guidance (can be found here). Please be sure to replace your primary oxygen sensor if any signs of sensor inaccuracy or wear are present.

Every engine and every kind of fuel may indicate a different fuel ratio. However, most NA Honda applications utilize a leaner mixture of fuel to air when under high load. Depending upon fuel quality a normal “WOT” fuel mixture may be mid 13s (0.92 to 0.89 lambda) to mid 12s (0.88 to 0.85 lambda). Under more moderate load conditions, fuel ratios can be run much leaner. Most FI Honda applications utilize a richer mixture of fuel to air when under high load. Depending upon fuel quality a normal “WOT, on boost” fuel mixture may be mid 12s (0.88 to 0.85 lambda) to low 11s (0.79 to 0.75 lambda). Under more moderate load conditions, fuel ratios can be run much leaner. Supercharged applications will likely need a slightly richer fuel curve than a turbocharged application due to the increased intake air temperatures realized with this application due to a lack of an intercooler.

Fuel Injector Latency

Table Description – The Fuel Injector Latency table contains latency values used to tell the ECU how much latency is needed to properly control the fuel injectors at differing battery voltage. All fuel injectors require a certain amount of time to fully open which is referred to as Injector Latency. This property may also be referred to as injector dead time or dwell time. The amount of latency an injector has is dependent on several factors such as Battery Voltage and Fuel Pressure. Lower battery voltage will increase the injector's latency (dead time). Likewise, higher Fuel Pressure may also increase the injector's latency. The factory ECU has an Injector Latency adjustments table based on Battery Voltage. The data in this table is represented in milliseconds; this is the only table that exists for the sole purpose of adjusting injector latency values. A higher value will open the fuel injector sooner, thus the total IPW will be greater; a lower value will open the fuel injector later, thus the total IPW will be less.

Tuning Tips – Most fuel injector manufacturers will be able to provide you with this latency data and the voltage they are referenced at. Use that as a starting point and modify from there. Don't be afraid if your final values differ from what the manufacturer provided. To tune this table, we suggest that you first establish a good Injector Scale value.

One way to find the correct latency (or at least the latency that works best with the injector drivers in the ECU and your particular injectors) is to have your fuel system running stock fuel pressure and have the stock intake system installed then;

1st - set the proper scale value for the injectors you are using based of the scaler calculation.
2nd - start the engine and let the car warm up to temperature (coolant temperature between 180-195 F and intake air temperature +/- 15 degrees F of ambient temperature) then re-set the ECU so your fuel trims start at zero.
3rd - start the vehicle again and watch the **SUM of your fuel trims, Short-term Fuel Trim + Long-term Fuel Trim.**

If you see that the SUM of your fuel trims (A/F Trim Mimed. + A/F Trim Learned) is positive then add injector latency until you see the SUM of your fuel trims come closer to zero. You will have to test this throughout the operating range of the engine...the entire MAF curve. Try to avoid sudden throttle movements during this process, you want to avoid seeing any corrections based on the Enrichment table settings.

If you see that the SUM of your fuel trims is negative then reduce injector latency until you see the SUM of your fuel trims comes closer to zero. You will have to test this throughout the operating range of the engine...the entire MAF curve. Try to avoid sudden throttle movements during this process, you want to avoid seeing any corrections based on the Tip-in Enrichment table settings.

This is part of a calibration process that should be able to get you close to the ideal settings necessary to properly control your fuel injectors. Please take into account that you will most likely have to fine tune the intake calibration table as the final step. This will be necessary to match the characteristics of these new fuel injectors.

Precautions and Warnings – When fuel injector latency is increased, total fueling will be richer across the entire operating RPM range. When fuel injector latency is decreased, total fueling will be leaner across the entire operating RPM range.

Knock Feedback Tables

The Honda Knock Feedback look-up functions depend on the camshaft phasing that is being run and whether or not VTEC is on the low camshaft or high camshaft profiles.

Knock Sensitivity CL/Low VTEC @ A Cam Advance

Knock Sensitivity CL/Low VTEC @ B Cam Advance

Knock Sensitivity CL/Low VTEC @ C Cam Advance

Knock Sensitivity CL/Low VTEC @ D Cam Advance

Knock Sensitivity CL/Low VTEC @ E Cam Advance

Table Descriptions – These tables are all 3-dimensional and defined by engine RPM on the horizontal axis and calculated engine load on the vertical axis. The numbers in the table represent the sensitivity of the knock detection system and authority to make ignition advance changes. The lower the number, the more sensitive the knock detection system is and the more authority the system has to modify ignition advance based on analyzed engine noise. The higher the number, the less sensitive the knock detection system is and the less authority the system has to modify ignition advance based on analyzed engine noise. If engine noise is determined to be too high for the given conditions (based on the values in these tables), the ECU has the ability to remove ignition advance. As with the ignition advance tables, these tables are used based on whether or not the engine is in closed-loop or open-loop, what intake camshaft phasing is being run, and whether or not the engine is on the Low or High VTEC camshaft profiles.

Tuning Tips – These tables are calibrated well for engines running 89-91 octane fuel. If you see that the engine is running less ignition advance than desired and you are confident that the engine can withstand increased engine noise, then you can simply increase the values in these tables until the ECU's ability to respond to engine noise is lessened. If you see that the engine is running too much ignition advance or is exceeding MBT, then you can decrease the values in these tables until the ECU's ability to respond to engine noise is increased. You can also simply remove ignition advance from the primary ignition look-up tables.

To tune the ignition advance curve for WOT, you should run a excessively rich fuel curve (something around Lambda of 0.81 or a low 12:1 AFR Petrol) for a normally aspirated engine. You will need to datalog the following variables: RPM, Ignition Timing, Throttle Position, Knock Retard, Engine Load, and Actual AFR. For tuning of these we suggest you start of with less total ignition advance than is optimal, that way you can work your way up from there. Generally speaking, a Honda K-Series engine will run a relatively flat timing curve. This trend is normal for most internal combustion spark ignition Honda engines; as VE (Volumetric Efficiency) increases the amount of ignition advance a engine needs will decrease. As you cruise a engine’s VE will not be the highest on an engine because the engine is not ingesting much air under cruise conditions so ignition advance will usually be higher. As VE increases at WOT (when the engine is ingesting as much air as possible) ignition advance will go down to a lower point until the VTEC cross-over when torque increases slightly then it will maintain a relatively flat ignition advance curve during the torque plateau. Once torque begins to fall off you will see ignition advance increase at higher RPM. This is due to the decreasing VE and is also done in order to keep up with the increasing piston speeds; you have to start the burn earlier so that the pressure wave expansion occurs at the optimal time.

We have found that one must have a chassis dyno to help find the thresholds for maximum ignition advance for a particular engine and the fuel that is being used. The following section should give you a much better understanding as to how the factory ignition system works and what you are trying to do by tuning your ignition advance curve. The objective of ignition tuning is very simple. You are trying to start the flame front, BEFORE Top-Dead-Center (TDC), so that the peak of the combustion chamber pressure wave pushes down on the piston AFTER TDC at the same time. This is why values in the ignition advance tables are in degrees of ignition advance BTDC. We must first go over how the ECU calculates total ignition advance before we can attempt to tune the ignition advance curve:

Total Ignition Advance =

The ECU will look-up the p**rimary ignition table value** for the corresponding RPM and Calculated Engine Load breakpoint for the camshaft advance that is being run then,

- removes **Knock Retard adjustments made by ECU within the Knock Detection range**. Within the Knock Detection range, the ECU can make a final adjustment to remove ignition advance is it hears the engine noise is getting too close to the threshold, as determined by the corresponding Knock Sensitivity table settings. The ECU will do what it can to protect the engine.

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Limiter Tables

Boost Cut A

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

ECT Over Temp

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

ECT Under Temp

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

LTFT Limits

Table Description – These values allow the limits for LTFT learning to be capped. The negative value is the greatest negative LTFT value that can be learned. The positive value is the greatest positive LTFT value that can be learned.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

MAP High Value

Table Description – This table contains the pressure value the ECU uses to determine an over-pressurized situation or overboost.

Tuning Tips – These tables can be used as a primary boost limit safety table.

Precautions and Warnings – None at this time.

MAP Low Value

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

Rev Limiter - Disengage Fuel Low VTEC

Rev Limiter - Reengage Fuel Low VTEC

Rev Limiter - Disengage Fuel High VTEC

Rev Limiter - Reengage Fuel High VTEC

Table Description – These are engine speed values that represent the switch when the ECU cuts fuel delivery to the engine and reengages it after the overrun condition. These tables are used to define the maximum allowable engine speed. Fuel delivery is blocked and other overrun parameters enabled to keep engine speeds below these set points. The right table cell values are used for normal conditions, no MILs present.

Tuning Tips – Stock engines with stock valvetrains should keep their stock maximum engine speed. In some case throttle mapping must be changed in order to effectively raise maximum engine speed.

Precautions and Warnings – Increasing engine speed produces exponentially higher forces on the engine components and oiling systems. Increasing allowable engine speeds may produce catastrophic engine failure.

Rev Limiter - Disengage Fuel Master

Rev Limiter - Reengage Fuel Master

Table Description – These are engine speed values that represent the switch when the ECU cuts fuel delivery to the engine and reengages it after the overrun condition. These tables are used to define the maximum allowable engine speed. Fuel delivery is blocked and other overrun parameters enabled to keep engine speeds below these set points. The right table cell values are used for normal conditions, no MILs present. The left table cell values are used for stationary conditions, no MILs present.

Tuning Tips – Stock engines with stock valvetrains should keep their stock maximum engine speed. In some case throttle mapping must be changed in order to effectively raise maximum engine speed. The left table cell values can be set to the same RPM and used for a Launch Control (LC) condition.

Precautions and Warnings – Increasing engine speed produces exponentially higher forces on the engine components and oiling systems. Increasing allowable engine speeds may produce catastrophic engine failure. By setting table values in order to set up a LC, you understand that you can break all sorts of stuff (axles, clutch, pressure plate, etc.) by launching your vehicle from a standstill. Cobb Tuning, LLC is not responsible or liable for any consequences, mechanical or electronic, foreseen or unforeseen, that may result from the use of a calibration that has LC functionality; the transfer of this calibration to the vehicle acknowledges the user accepts these terms.

Speed Limiter

Table Description – One of vehicle speed that represent the maximum allowable vehicle speed under a given set of other conditional parameters. This value limits speeds above these thresholds will result in throttle closure.

Tuning Tips – None at this time.

Sensor Calibration Tables

BARO Sensor Multiplier

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

BARO Sensor Offset

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

ECT Sensor

Table Description – This single row table describes the non-linear calibration of the stock engine coolant temperature (ECT) sensor according to sensor voltage.

Tuning Tips – None at this time.

IAT Sensor

Table Description – This single row table describes the non-linear calibration of the stock intake air temperature (IAT) sensor according to sensor voltage.

Tuning Tips – None at this time.

MAF Sensor

Table Description – This single row table describes the non-linear calibration of the stock mass air flow sensor over a voltage range over its useful output of zero to nearly 5 volts. The values in this table represent an stoichiometric mass of fuel to the amount of air moving through the stock intake. The MAF Calibration table contains values which tell the ECU the MASS of air entering the engine for the given MAF voltage. These values allow the ECU to properly calculate the mass of the fuel it needs to inject into the engine to get the air/fuel value dictated in the fuel tables or by the closed-loop control targets, 1 Lambda. The factory ECU airflow adjustments table is based on MAF Airflow. The data in this table is represented in grams per second; this is the only table that exists for the sole purpose of adjusting MAF transfer (or MAF calibration) values. Under closed-loop conditions the ECU is always going to try and hit 1 Lambda or the stoichiometry of the fuel you are running. You will be most familiar with the associated petrol air/fuel ratio of 14.68:1 A/F, which is an air mass of 14.68 to every 1 fuel mass.

Tuning Tips – The equivalent fuel mass values derived from the intake calibration are the primary consideration when the ECU is calculating fuel, ignition timing, and load. It is this value and not boost that determines the engine load and thus all critical engine control parameters. With a stock intake it is rarely necessary to significantly alter this calibration. However, after market intakes pass air across the mass air flow sensor differently and ofter need considerable changes in order to yield acceptable results. This accurate calculation of engine load is critical for the dozens of other tables that use engine load to define a axis. To calculate your MAF Calibration adjustments, please follow the below steps.

STEP 1 - How to set up the AccessPORT or AccessTUNER software to capture the correct information for a MAF calibration revision. If your LTFT values are exceeding +/- 8%, then we suggest you complete the follow MAF calibration datalogging, analysis, and MAF calibration revision. You want to make sure the following variables are checked for data logging. These variables are the 10 default variables (on the AccessPORT) with the inclusion of STFT, which you will have to add:

Actual AFR (AFR, lambda, AFR)
Calculated Load (load, load, load)
Coolant Temp. (F, C, C)
Fuel Trim (Long) (%, %, %)
Fuel Trim (Short) (%, %, %) = Please be sure to add to your log list.
Ignition Advance (deg, deg, deg)
MAP (PSI, kPA, kPA)
Mass Airflow (g/s, g/s, g/s)
RPM (RPM, RPM, RPM)
Throttle Position (%, %, %)
VTEC Status (ON, OFF)

The variables in bold are actually the only ones necessary for a MAF batch datalog. We have noted this because the AP will log at higher sample rates with fewer variables logged. Although, it is not critical to just log those items as long as you collect an appropriately long datalog that has sufficient information.

After you have reflashed the map that best matches the performance hardware installed on your vehicle. We suggest you street drive at light to moderate throttle for a minimum of 10 minutes or 10 miles. Turning the vehicle fully off and on at least twice during this period is helpful (please do not turn the vehicle off while you are driving, simply pull over in a parking lot and turn the car off, then back on). This will allow the ECU to learn initial fuel trims. After this learning period, if you notice that your fuel trims (specifically LTFT) are exceeding + or - 8%, then please complete the following datalogging procedures so that appropriate datalogs can be recorded and analyzed using the following steps.

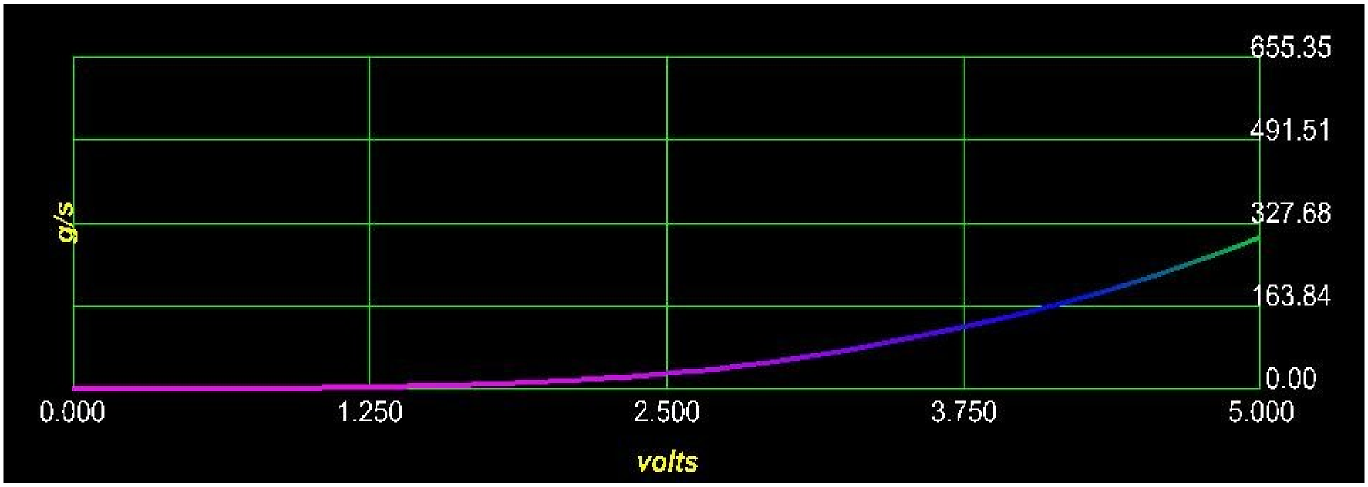
This test should be done carefully. Allow the vehicle to idle for a few minutes, then drive for about 10 city miles at light to moderate throttle (as noted above). Please make sure the ECU has not been reset or the battery disconnected for these 10 miles. Set the AccessPORT up to datalog the standard 10 AccessPORT variables along with Fuel Trim (Short) or STFT. This variable will need to be added to the datalog list. Be sure to have Mass Airflow displayed on the AccessPORT screen or AccessTUNER dashboard as you prepare to capture this datalog. Start driving the car around under light throttle conditions so the ECU can calculate what changes need to be made using the closed-loop feedback system. While driving, try to modulate the throttle so the MAF Airflow values vary from 8-20 grams/sec (a normal airflow value for light throttle) to 80 grams/sec over the next 5-10 minutes; please be sure to accelerate at a steady rate until you exceed 80 grams/sec airflow. It is likely that you will need to modulate the throttle to full throttle to exceed 80 grams/sec during this test, this is normal. You do not need to exceed 4800 RPM or the VTEC engagement point during this datalogging period. After you have completed sufficient driving for this log that modulates MAF Airflow between 2-80 grams/sec, please put the car in neutral and allow the car to idle for almost a minute, then stop the datalog. This will allow us to see what type of fuel trim learning the ECU is doing to compensate for the fuel being run through the engine, the intake system, and other hardware that is installed on this car. Ideally, you want your LTFT values to be closer to zero. Anything within +/- 8% is acceptable, but closer to 0% LTFT is ideal.

The objective is to observe the various adjustment that have been saved by the ECU at various breakpoints along the MAF curve. With this information, you will be able to fine tune your MAF calibration.

Again, this is really nothing to panic about. If your vehicle is running leaner than desired or is safe, then simply stay out of WOT and heavy loads. For you to optimize your map based on your datalogs is very simply. You will literally go into a MAF sensor calibration table, apply the LTFT learning values appropriately (based on your recorded datalog), save the map and reflash it on your ECU using the AccessPORT. You install this new map and vuola, your LTFT values will now be closer to zero and your WOT fueling is at to or closer to the targeted 13.1 AFR petrol. It may take 2 to 5 MAF calibration revisions to get the calibration performing more consistently. It may be that you need to modify your mapping as you continue to install various parts on your vehicle. I have attached a Sample MAF Batch Analysis spreadsheet that you can look at for reference.

Generally speaking, if your WOT fuel curve is within +/- 4% of 13.1 AFR petrol, we see no reason to modify a map. If your LTFT values are within +/-8% while driving at part throttle, this is an acceptable range. If your LTFT values exceed +/- 8%, you are welcome to use the AccessTUNER and follow these steps to modify a map for your specific vehicle.

STEP 2 - How to organize the data in the datalog.csv in order to allow for appropriate analysis.
- First, use a spreadsheet program to open your .csv file.
- Re-save the file as a spreadsheet file (.xls for MS and .ods for OO) so your advanced functions and graphs will save appropriately.
- Copy the Fuel Trim (Long) (%), Fuel Trim (Short) (%), and Mass Airflow (g/s) column so you can paste them to the right of the existing information. We have done this in the above sample MAF Batch Analysis spreadsheet (we italicized the text with a blue back-ground color).
- Highlight these three columns and sort them in ascending order by Fuel Trim (Short) (%).
- Copy and paste the data rows that have negative (-) or positive (+) STFT values to the right again. We have done this in the sample sample MAF Batch Analysis spreadsheet (text in bold with a green back-ground color). By eliminating the rows of data that has 0% STFT data, you are eliminating data that was recorded while decelerating or while in open-loop fueling, this data is not useful for MAF calibration refinement.
- Highlight this second set of three columns and sort them in ascending order by Mass Airflow (g/s). This will arrange the data in a manner that will allow you to analyze your accumulative STFT values with the corresponding Mass Airflow (g/s) values. This information will be used to analyze what changes you should make to your MAF calibration in the AccessTUNER software, see below Step 3.

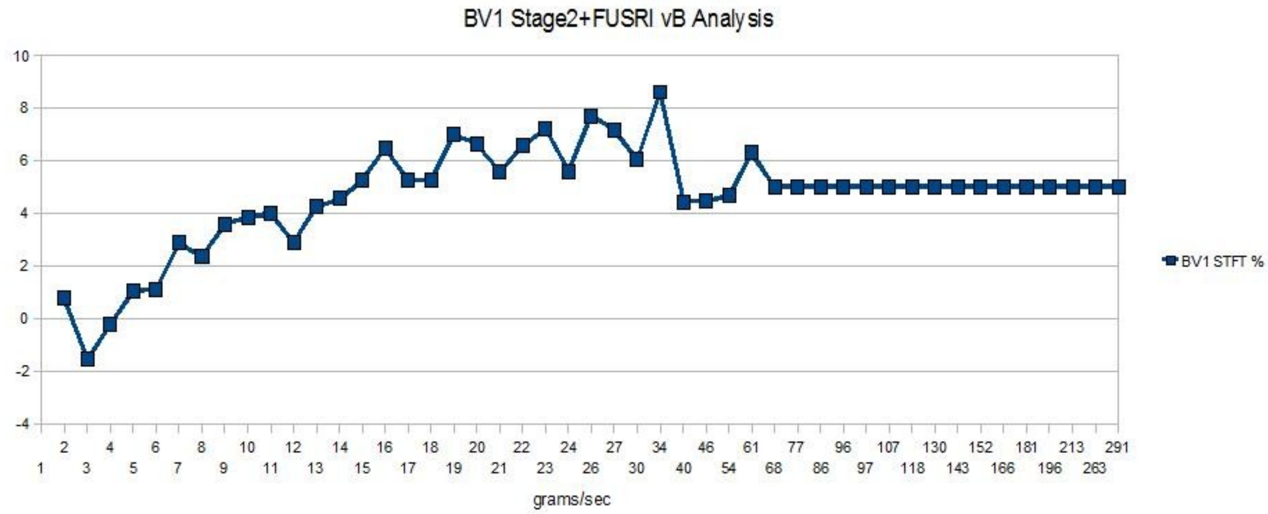


STEP 3 - How to apply fuel trim data to your MAF calibration in order to fine tune your MAF calibration. This next step is a bit complex, but very easy to understand once you have reviewed the information on the spreadsheet. For each gram/sec breakpoint value (2.00 - 2.99, 3.00-3.99, 10.00-10.99, etc.), you want to sum up the STFT values and divide them by the number of samples that are being summed. You can see these analysis points have been highlighted with a red back-ground, the text is in bold and has been centered. You can go to these summation points and press the F2 key to see the math equations that we have already entered. These equations can be modified to include different data points that match the data you have logged. This step uses an average of the summarized data in order to determine what percentage corrections need to be applied to the MAF calibration for each grams/sec break point along the entire MAF calibration for the closed-loop points. Now you can take the information in the spreadsheet and use the first tab (labeled "Analysis") in order to help determine how you should modify your MAF calibration based on this accumulated data. Each tab of recorded MAF Batch datalogs can be used to get a greater average of what changes can be made to your MAF calibration table.

This part is fairly straight forward, if you see that the average STFT value for 3.00-3.99 is -9.2%, then you will want to go to the MAF calibration table and highlight the cells that have MAF Airflow values between 3.00-3.99, then press the M key which allows a multiplier value to be applied. The multiplier for this situation would be .908 (1 - .092), this will apply a 9.2% reduction to the value in these cells. This adjustment will now tell your ECU for that particular MAF voltage you now have 9.2% less MASS of air entering the engine so 9.2% less mass of fuel should be injected, bringing your fuel trims close to zero.

If that summation is +6% then you can highlight the MAF Calibration cell for that particular MAF Airflow and hit the "M" key, you will then be prompted to enter a floating point value. The correct value for this particular situation would be 1.06. This adjustment will now tell your ECU for that particular MAF voltage you now have a 6% greater MASS of air entering the engine so 6% more mass of fuel will be injected. After this adjustment is made and your ECU flashed with the map, your A/F Trims should be closer to zero. We suggest you shoot for a LTFT value of +/- 8% max.

This worksheet also has a graph (similar to the one posted below) that we have created so you can better visualize the summary of this data.



This is just one model for data analysis. We may publish different models or different tuning techniques in future tuning guides.

NOTE: Changing the Intake Calibration table will change your calculated load. If all other variables remain constant, the less airflow you calibrate in the ECU for a given MAF voltage; the less engine load will be calculated.

Precautions and Warnings – Modifying this table will then modify how the ECU calculates torque! Nearly every important table utilized for coordinated engine function is defined in part by engine load and this is derived from the mass air flow sensor calibration of the intake. A mistake in this table can cause catastrophic engine damage.

MAP Sensor Multiplier

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

MAP Sensor Offset

Table Description – None at this time.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

Primary O2 Sensor

Table Description – This is a 2-dimensional table defined by primary oxygen (O2) sensor milliamps on the horizontal axis and contains the lambda or air/fuel ratio value. This table can be effectively used to recalibrate what the stock primary O2 sensor reports.

Tuning Tips – None at this time.

Precautions and Warnings – This table can be used to modify the calibration for the stock primary O2 sensor and should be modified with caution. Overly lean fuel mixtures under can quickly damage the engine and other components. Always monitor Lambda or Air Fuel ratios using an external, professional Lambda meter when performing calibrations. If you are unsure of what kinds of fuel mixtures to target please examine stock calibrations and Cobb Tuning OTS calibrations for guidance (can be found here). Please be sure to replace your primary oxygen sensor if any signs of sensor inaccuracy or wear are present.

Throttle Tables

Throttle Table A

Table Description – This table represent how the Accelerator Pedal Position (APP) values are reported to the ECU in order to control the drive-by-wire (DBW) electronic throttle system. The x-axis values in these tables are APP read-only values and the cell data is the reported APP values that are used by the ECU for throttle controls. The y-axis values are engine RPM. These tables use read-only APP values to look-up a APP value that is reported to the ECU for throttle controls.

Tuning Tips – The stock values work very well. If you are to modify these values, we highly suggest you drive the vehicle and datalog APP and TPS values to get a better idea about how this vehicle drives with the various changes.

Precautions and Warnings – If you are to modify these values, we highly suggest you drive the vehicle and datalog APP and TPS values to get a better idea about how this vehicle drives with the various changes. These vehicles tend to use switching functions for closed-loop to open-loop transitions. Please be aware of this as you start to modify any throttle control table settings.

VTEC Tables

High VTEC Engagement RPM Primary

High VTEC Disengagement RPM Primary

High VTEC Engagement RPM Secondary

High VTEC Disengagement RPM Secondary

Table Description – These are engine speed values that represent the switch to engage and disengage the High VTEC Cam lobes. These values control when the VTEC system goes from Low Cam to High Cam.

Tuning Tips – Stock engines with stock valvetrains should keep the OTS map values. In some case additional improvements can be made, but extensive testing will be necessary. Ideally, you can set VTEC to engage every 200 RPM and run dyno tests to see what is the ideal RPM to engage the High Cam VTEC system. If torque significantly dips as you engage High Cam VTEC and picks back up at later RPM, then the High BTEC RPM engagement is likely set too low. If torque is significantly dropping before you engage High Cam VTEC, then the High VTEC RPM engagement is likely set too high.

Precautions and Warnings – Setting the VTEC engagement points too low is potentially dangerous because the engine may not have sufficient oil system flow to engage the system and maintain proper engine oil pressure.

High VTEC Engagement Load Dependency

Table Description – This table contains engine load values that must be exceeded in order for VTEC to engage the High Cam lobes. These values control when the VTEC system goes from Low Cam to High Cam as long as both the VTEC Engagement RPM and Load Dependency values are met.

Tuning Tips – This table can be used to refine the VTEC Engagement "window". If torque significantly dips as you engage High Cam VTEC and picks back up at later RPM, then the High BTEC RPM engagement is likely set too low. If torque is significantly dropping before you engage High Cam VTEC, then the High VTEC RPM engagement is likely set too high.

Precautions and Warnings – Setting the VTEC engagement points too low is potentially dangerous because the engine may not have sufficient oil system flow to engage the system and maintain proper engine oil pressure.

Toggles (Base)

Closed Loop

Toggle Description – This toggle is the main function switch for turning the closed-loop feedback system ON or OFF. If the box is checked, then closed-loop system will operate as it would normally based on other table settings. If the box is unchecked, this will turn closed-loop feedback off.

Tuning Tips – You can turn the closed-loop functionality off for tuning or you can use the closed-loop system to indicate what tuning changes need to be made.

Precautions and Warnings – If a turbocharger is added to the vehicle, running a car without any high-flow catalyst can allow the turbo to overboost or boost spike. These toggle may need to be modified in order to allow for open-loop fueling during race conditions.

Power Steering Control System

Toggle Description – This toggle is the main function switch for turning the PSCS system ON or OFF. If the box is checked, then the PSCS system will operate as it would normally based on other table settings. If the box is unchecked, this will turn the compensations for the PSCS system off.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.

Vehicle Dynamic Control

Toggle Description – This toggle is the main function switch for turning the VSA feedback system ON or OFF. If the box is checked, then the VSA system will operate as it would normally based on other table settings. If the box is unchecked, this will turn the VSA system off.

Tuning Tips – None at this time.

Precautions and Warnings – None at this time.
