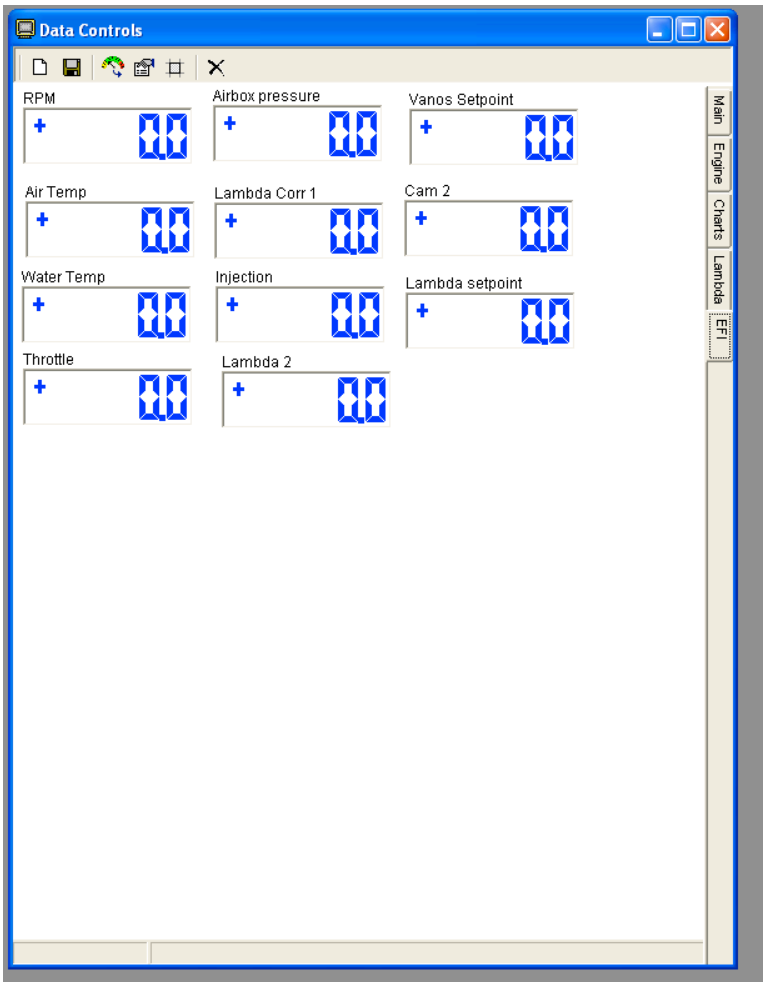
Getting Started with EFI

Notes assembled by BOE Fabrication, LLC

Read this entire tutorial BEFORE starting the car, loading maps, etc. Do NOT SKIP the glossary. It's imperative that you know the terms.

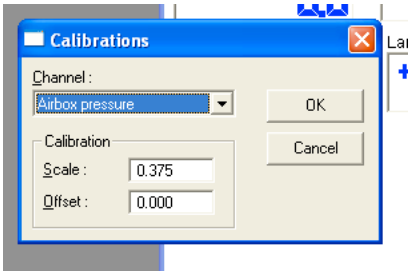
Before you even plug the laptop up to the EFI, you should setup your "data controls" and ECU Calibrations as below (no harm done if you already plugged it in though):

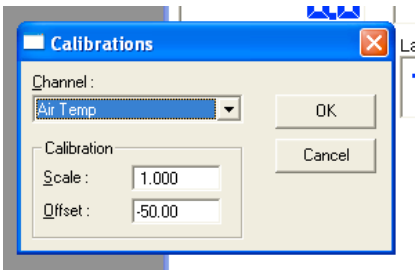
I. Data Controls
   a. Install EFI software on your laptop.
   b. Open Editor. You MUST-MUST be running an Editor version 7.1.11 or newer. If you're not, you need to DL a more recent version from our website or get it from DRS.
   c. Configure the data control screen as follows:
      - Power to Win installed
      - Laptop NOT connected to car

      1. 

   d. Be sure to "save" your setup by clicking the save symbol <u>ON THE DATA CONTROLS WINDOW</u>

II. Configure your ECU calibrations. This will ensure that your ECU is setup to give you temps in degrees C and read your 3 bar MAP correctly.
   a. Laptop does NOT need to be connected to the car for this step.
   b. Locate the icon with the pencil on it next to the race track:
   c. 

   d. Configure your airbox pressure as so (must be a GM style 3bar maps sensor, as supplied with the kit):
   e. 

   f. Configure BOTH your air temp and water temp channels as so:
   g. 

Connecting

Next you need to connect the EFI to the ECU. The single most common problem folks run into is with their serial to USB converter. If the EFI is not "talking" to your laptop through your convertor, you probably have the wrong port number. It's a windows problem. Your com port for the serial converter needs to be on com 1, 2, 3, or 4. Once we have this set in Windows, always use the same USB port from then on.

1. Close the EFI nEditor if it is open.

2. Be sure your USB to Serial Converter is plugged into the laptop with need drivers loaded
3. Converter should not be connected to the EFI.
4. Set the right port on Windows: Right click on “my computer” on your desk top and then click “properties”.
5. Click the “hardware” tab in the window the “system Properties” window
6. Click the “device manager” button.
7. Click the “ports” icon in the list of devices (it looks like a little plug)
    a. It should expand down and you should see your USB to Serial converter listed. Double click it.
8. Click “port settings” tab.
    a. Within the Port settings tab, you should see a drop down menu where you can select an unused port. Select the lowest port that’s available from 1-4.
9. Click OK, and start OKing backward through the screens.
10. Now open nEditor.
11. Go to “file”.
12. Click “port settings”
13. Select the corresponding port number that you selected a moment ago
14. Leave stop bits and parity as they are at two and none, respectively.
15. Click OK and close down the nEditor.
16. Connect your EFI to the laptop
17. Turn the key on.
18. Open nEditor.
    a. It should connect.
    b. The “On Line” indicator should be glowing bright green at the center top of the screen.
    c. “Work Offline” should be dark green- insinulating that we’re working ONLINE. If this is bright green, click it so that it goes dark green and we’ll then be working ONLINE.
19. You’re done with the port settings now. You should not need to do this again.
20. Next step is to load your map

Map Loading and Switching…

So you’ve got this map, now how to load it.

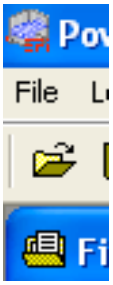
A few things to know:

- All Maps should be saved in the “maps” folder within “power to win” on your C: drive
- It’s OK to create sub-folders with in the “maps” to stay organized.
    - IMPORTANT: Every folder that contains a map, must contain a copy of the file named “control” within the actual folder that the map file is found.

        - The “control” file tells the editor what to do with the map. Just copy and paste in any subfolder within the map folder that contains a map.
- It’s perfectly OK to load new maps while the car is running
- You should be using EFI Editor, 7.1.11 or newer!
    - If not, DL a new editor off of our website.

Loading a map.

- EFI must be connected to laptop
- nEditor Opened
- Key on, Engine OFF
    - IMPORTANT: Do not try to start the car unless you have verified you have a “good” map installed that is configured for your car.
- Working Online
- Map to use in the maps folder with a control file within the same folder

1. Click the “file open” icon. “File Open” is synonymous with “Replace File” as seen in the “file” menu at the top of the screen.
    a. 

2. Select the map you want and click OK
    a. You will likely here a series of clicks
3. Your Map is now ready to run or change.

Initial Checks and Configuration

For all steps below, the following criteria should be met

- Key On, Engine OFF
- nEditor Open
- Working Online
- Map is loaded into ECU
- IMPORTANT: Take note of the throttle position as reported in the “Data Controls” window.

TPS (Throttle Position Sensor) Configuration

You'll need to configure a handful of TPS settings which are found in the window labeled File (1) Folder.

1. Idle (skip this step ONLY if DBW; 2006 cars and Later)
    a. Expand the IAC/Idle Speed Section
        i. Double click "Idle Constants"
    b. Double click the area where the "throttle limit (deg)" number is.
        i. Insert a number that is 1.5 GREATER than your throttle reading indicates.
        ii. This number indicates when the IAC (idle Air Control) becomes active. It should do this about 1.5 -2.5 degrees before reaching idle.
    c. BEFORE clicking apply, click in another numerical cell on the screen to ensure that the value you input stuck.
    d. Once satisfied, the value is locked in, Click apply and close the window.
    e. Click the Save icon
2. Accel /Decel (all cars)
    a. Expand Accel/Decel
        i. Double click the "Constants"
        ii. Locate the "Throt Cutoff Limit (deg)"
            1. Insert a number in the field 1.5 greater than your resting throttle position. Just as instructed above.
            2. Click in an adjacent cell to ensure the value you entered stuck.
        iii. Click apply and close the window.
    b. Click Save Icon.

Pre Startup Checks:

- Lambda 2 should be reading about 1.1 (for Wideband 02 setups)
    - If not, something is wrong:
        - Is your WB 02 is not calibrated to AIR
        - Is your map configured for the WB 02 sensor you're using?
            - If not, you will need some help.
- Airbox Pressure should read about 30, +/- 2.5
- Air Temp should be about ambient (in degrees C)
- Water Temp should also be about ambient (in degrees C)

Time to Start the Car!!!

BEFORE STARTING, Have you read and studied the glossary terms? If not, STOP and go do that now.

ALSO, BEFORE STARTING, did you do everything above without skipping a step? If in doubt, check again…

NOW, Proceed☺

The car should start pretty easily. You may struggle with it just a tad until you get it fine tuned. A blip of the throttle typically helps an untuned car tick over.

Upon start up, you should verify a few things:

- RPM- Typically idle around 1,200
- Cam 2 should read approx 55, +/- 5. It will move around a bit
- Airbox pressure should read between 9 and 11 or so. If much higher than 11, you may have a vacuum leak.
- Lambda 2 will fluctuate and read rich until the car is warmed up.
- Lambda Corr 1 will likely read 0 until the car warms a bit.
- Air temp is post turbo/super charger and it will raise quickly.

If all looks reasonably well, you can take the car for a test drive. Pay CLOSE attention to your AFRs to be sure you have a sufficient fueling while under boost. Low 12s to high 11's is ideal for fueling at WOT (wide open throttle).

Typical Items That Need Attention and Fixes

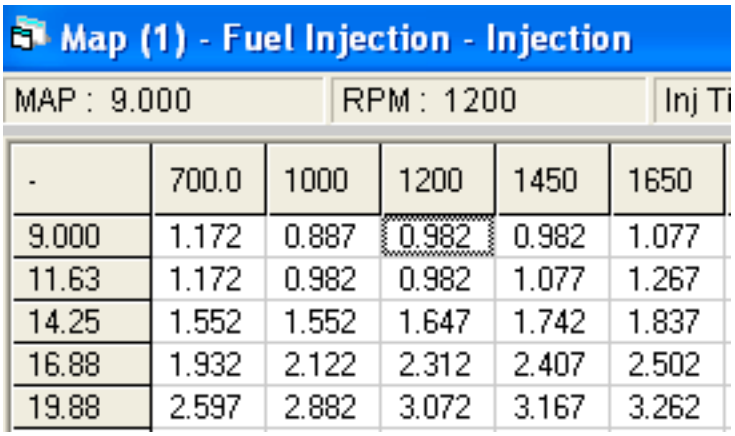
Idle

Got a choppy idle? Some cars will more than others. Depends much on the exhaust, intake, air temp, etc…

The fix (all cars), Part 1:

1. You should target an idle of about 14.7-15.2 AFR which is about 1-1.05 Lambda.
2. Expand the "Injection" section
    a. Open "Injection" with double click.
    b. You'll see a pretty looking fuel map.
    c. Right-click the map and select "show numeric". This is the actual milliseconds of injection time that is firing the injectors.
3. Using the "+" (plus) and "-" (minus) buttons, you can increase or decrease the values of the cells in EITHER numeric or graphical view.
4. Turn the "active cursor" on by clicking the icon at the top of the screen so that it is bright green.
    a. This will show you what cell the EFI is referencing.
5. With the cursor on, add or subtract fuel to the cell in use one or two clicks to bring your idle mixture to between 1 and 1.05. GO SLOW. It is IMPORTANT that the adjacent cells have similar values. There should NOT be any large spikes or valleys in fueling in one cell relative to another. The EFI averages

the cells in an area and it may "hunt" a bit. As it hunts, you don't want it moving to dramatically different values or it will perpetuate the hunting and drive you nuts. An example what the idle section of a working map might look like is below.

a. 

-	700.0	1000	1200	1450	1650
9.000	1.172	0.887	0.982	0.982	1.077
11.63	1.172	0.982	0.982	1.077	1.267
14.25	1.552	1.552	1.647	1.742	1.837
16.88	1.932	2.122	2.312	2.407	2.502
19.88	2.597	2.882	3.072	3.167	3.262

b. NOW, keep in mind to smooth out the neighboring cells, you'll need to toggle active cursor off so that you can move the cursor away from the cell the EFI is using.

6. This process may take a good 20-30 minutes, especially as you're getting used to it. I can do it 5 minutes now, and you'll get there too as you learn the software.

Part 2: Applies only to 2005 cars with cable throttle bodies…

First be sure you have adequate throttle opening at idle. It's quite typical that you may need to adjust the throttle stop to garner a solid 1,200 RPM idle. There is an idle stop screw you can adjust. I've also seen folks just slight tweak the throttle stop tab, as it's just thin sheet metal. Whatever works for you… Once that idle is at a good 1,200-1,300 rpms, repeat above step 1. If you're still having an oscillating idle, you may need to lower/reduce the "proportional gain" by 10, which is found in the idle constants.

Glossary of terms:

I. EFI Tips and Glossary

a. **Lambda:** This is simply the term for AFR (air fuel ratio). A lambda reading of 1 is an AFR of 14.7. Your EFI only displays AFR in terms of Lambda. To equate Lambda to AFR, you simply multiply the Lamda value by 14.7. Ex: 0.80 Lambda equals .80x14.7=11.76 AFR. Or say you're shooting for 12:1 AFR. Simply take 12/14.7=.816 Lambda. Easy, huh?

b. **Lambda Corr 1:** Also known as short term fuel trims. Most maps have the window for fuel trims set to +/- 15%. In other words, if you set

your target AFR for a particular load/rpm site (known as Lambda Setpoint) to .85 Lambda and your fuel map is overly rich in the area you're telling the car to run .85L, then the ECU will pull fuel. You can tell what percentage of fuel it's pulling to achieve the setpoint of .85 by observing the Lambda Corr 1.

c. **VANOS:** This is a BMW term for variable valve timing. In the VANOS tab, you'll find all the setting for our cam timing.

d. **VVT:** Variable Valve Timing. Our engines have single VVT. Meaning that we can control the timing or phase of just one cam, and that is the intake cam.

e. **VVL:** Variable Valve Lift. The 2ZZ has the ability to change the lift of both the exh and intake cam. Good or bad, this action of increasing or decreasing the lift is an on/off occurrence. It is not variable as to how much left change you get and both cam change their lift parameters at the same time. You do have control of what RPM and what load this shifts takes place. Depending on the age of your EFI control file, the VVL adjustments will either be titled Exh cam or VVL. However, both titles are found in the same place within the VANOS chapter and in Constants subchapter.

f. **LAMBDA 2:** This is the output of your Wideband 02 Sensor. Anytime you're monitoring or see something pertaining to Lamba 2, you'll know that's the actual AFR in termsof Lambda. The channel labled "Labmda 1" is not used for the wideband systems.

g. **Airbox (Also Airbox Pressure, and MAP):** This is the channel your MAP input comes in on. Airbox, Airbox Pressure, and MAP are all synonymous for this ECU. This will always be displayed in units of inches of hg (mercury). See MAP below for more details

h. MAP: MAP is Manifold Air Pressure. It is expressed in inches of hg. This is the same thing as barometric pressure. You probably have one of these gauges in your kitchen. Typical barometric pressure is about 30, which is also known as 1 bar or 1 atmosphere. To turn in/hg into something you can relate to like boost psi, there is a conversion. You always can take the "x" in/hg and subtract 30 and then divide by 2 and you'll have psi. For instance, let's say your airbox pressure or MAP reading was displaying 48. That's 48 in/hg. Take (48-30)=18, then divide by 2 and you have 9. So 48in/hg equals about 9 psi boost. Intuitively, when you see 30, you know that's essentially just atmosphere, i.e. no boost and no vacuum. With your key on and the

engine not running, your MAP should be about 30 +/- 2. While this seems like a lot to remember, you'll get quite used to thinking about MAP is terms of in/hg rather than PSI…

i. **Cranking Pulse:** Found in the Fuel Injection tab and then fuel constants. This is the injection time that your ECU uses while you're cranking the engine over. You typically will have to fine-tune this for your car for the best starting possible. It's typical to see your injection time about 3X greater than your injection time at idle. For most cars, cranking pulse will be about 3-3500uSec which is 3-3.5m/s. Most cars will idle around 1m/s injection pulse width, as you'll see in your fuel map. Cranking injection **IS** manipulated by the temperature injection corrections. So if you find that your car starts perfectly on a 80degree F day, but not on a 30F day, you may need to steepen the inj vs coolant temperature curve.

j. **Cam Timing Setpoint or Intake Cam Degree or Vanos Setpoint:** There's a lot of work that goes into building a good cam timing table (recall this is for intake cam timing only). You have a good all around cam timing table with the map you were supplied with. Feel free to play with this setting, but best if done with the help of someone familiar with it and only on a dyno. NOTE, that playing with the cam timing will impact that amount spark the engine needs and the required fuel as well. So tread lightly here. The range for the cam setpoints are from 55 to 15. 55 is the most retarded and 15 is the most advanced. Those numbers don't really mean anything. They're just numbers. They are linear in the way that they adjust the cam timing. So 35 is in the middle of the available cam timing/phasing adjustment…

k. **Cam 2:** Cam2 shows where the intake cam actually is. So let's say you have your Vanos setpoint (referenced above) set to 30 at x load and y rpm, and you drive the engine that point. The Vanos setpoint will say 30 and Cam2 will show just how close to the desired 30 the cam actually is. It's typically with in 2 or 3 degrees of the set point.

l. **Air Temp:** The air temp shown is not outside air. It's represented in degrees C and is the IAT or intake air temp.

m. **Water Temp:** Represented in degrees C as well. Piggy backs off the stock sensor

n. **Injection:** This is the actually m/s that the injectors are firing. This is helpful for diagnosing problems with startup. All the numbers in your fuel map are actual injections pulses.

o. **Active Cursor:** If the Active Cursor button is illuminated, then the closest cell in your fuel or spark or intake cam map will be highlighted in some fashion that is being referenced by the ECU. This is particularly helpful when tuning. Be sure to turn the cursor off when you don't need it as you cannot work on cell that are not highlighted.

p. **Closed Loop:** This is when the ECU is controlling the fuel. As long as the Lambda Corr 1s are within +/- 15%, then the ECU is in charge. If you see that the L Corr 1 is pegging out at 15+/-, then you really need to make fuel map changes where the occurrence takes place. Make note that the ECU does not trim fuel unless the throttle is still. If the throttle is transient, it will not trim fuel. It will wait until the throttle has stopped moving.

q. **Check Sum:** If you're ever uploading new firmware or are suspicious of a corrupt file, check your checksum. It is specific to the firmware and will only show if the firmware is Okay.