Instructions for the MS Labs Basic MS3 ECU, V4.0b

Application: Mazda Miata 90-97 1.6L
Mazda Miata 94-95 1.8L

1. Download TunerStudio from tunerstudio.com and install. Forget anything you may have read about MegaTune or EasyTherm, it will not work with this ECU.
2. Decide which port you want to use (USB or serial). If you laptop has a true serial port, it is recommended over the USB port. You don't need any drivers if you want to use the serial port, just a serial cable. If you want to use the USB port, you need a USB cable, type A to type B. You will need to download and install drivers for the USB port to work; you can download them from:

   http://www.ftdichip.com/Drivers/CDM/CDM%20v2.12.00%20WHQL%20Certified.exe

   If the link above doesn't work for you, you can check if there's a newer driver at:

   http://www.ftdichip.com/Drivers/D2XX.htm

3. All Basic MS3s currently ship with firmware version 1.4.0. Please download the .ini file for this ECU here: https://www.mslabs.gr/Basic_MS3_140.zip
4. Make sure to save the above file on your desktop and keep a copy somewhere in case you need it again.
5. Unzip the file on your desktop. You should now have a file named "Basic MS3 140.ini". This file describes the features available in this ECU to the tuning software, TunerStudio. It is not a basemap. The basemap is already loaded inside the ECU.
6. **VERY IMPORTANT!!!!!** Remove the 10A "ST SIGN" from the engine bay fuse box. If you do not do this, the ECU will be damaged and you will not be able to start the car!!!
7. If your car is a 1.6L, you should also disconnect your stock TPS from the car. The ECU will not be damaged if you don't, however it will appear as if the ECU is not working at all. You will need to fit a variable TPS to take full advantage of this ECU. A typical and budget TPS is the Wells type 201.

   The above does not apply if your car is a factory equipped 1.8L. It ONLY applies if your car is an original 90-97 1.6L.

8. Remove the stock ECU
9. Run a vacuum line from the intake manifold, just after the throttle body, to the ECU (the connection is under the DB37 socket). If you don't do this, the car may not start at all, or may shoot black smoke out of the exhaust.
10. Connect the ECU to the stock harness.

11. If you want to use an open element IAT sensor, it must now be wired in.
    - On the US 90-93 1.6L (and European 94-97 1.6L), the IAT sensor replaces the sensor that is inside the AFM (Air Flow Meter). Disconnect the AFM, and pull back the rubber boot of the AFM's connector. You should see 7 wires on it. The IAT sensor connects to the red/green and black/green wires. No polarity.
    - On the 94-97 1.8L, the IAT sensor replaces the sensor that is inside the MAF (Mass Air Flow) sensor. Disconnect the MAF, and pull back the rubber boot of the MAF's connector. You should see 5 wires on it. The IAT connects to the red/black and black/green wires. No polarity.
12. Switch the ignition to ON, do NOT start the car yet. When you switch the ignition to ON, you should hear the fuel pump priming for 2 seconds.
13. Connect the USB cable to the PC. Windows should detect and install your cable.
14. After the device has been installed successfully, open the Device Manager (Control Panel -> System -> Hardware -> Device Manager) and click "Ports" to see which COM port it is under (usually between COM1 and COM10).
15. We are ready to connect to the ECU. Run TunerStudio.
16. Click File -> New Project
17. Give your project a name - anything will do.
18. Under ECU definition, click "Other" and browse to the .ini file you unzipped on your desktop.
19. Click Next
20. Select:
    - Oxygen Sensor: Wideband / AFR
    - Temperature display: Celcius/Farenheit (whatever works for you)
    - CAN_COMMANDS: Activated
    - INTERNAL_LOG_FIELDS: Deactivated
    - PW_4X: Deactivated
    - CYL_12_16_SUPPORT: Deactivated
    - PORT_STATUS: Deactivated
    - OUTMSG_EDITING: Deactivated
21. Click Next
22. Under Port, select the COM port you found the USB cable to be under (ie probably COM1 through 10)
23. Click "Test Port" - you should get "Successful". If not, try with other ports until you succeed.
24. Click Next.
25. Select the gauge style you want
26. Click Finish
27. You should see the gauges and you should be in Online mode.
28. Calibrate your TPS (if you have a variable TPS): Tools -> Calibrate TPS. Do not press the throttle at all, and click the top "Get Current". Then press the throttle fully, and click the bottom "Get Current" button. The click Close. Now when you slowly press the throttle, the "Throttle Position" indication should slowly go from 0% to 100%.
29. 90-97 cars must ABSOLUTELY set their base timing with a timing light!!! See page 5 for more information.

30. <u>A 37-way connector with pigtail is included with your ECU.</u> There are several free-

hanging wires on the connector, the following are the most likely to be used (depending on your request):

- White/Red: Fused 12V power supply for your wideband ONLY. Has an internal 6A fuse.
- Black/Yellow: Ground / Heater ground (for LC-1 widebands)
- Black/Green: Analog sensor ground.
- Yellow - Wideband input. Connect this to your wideband analog output
- Grey/Green – Switchable tables (optional). Connect this to a ground (through an on/off
  switch) to switch between VE/Ignition tables.
- Grey/Red – Launch control input (optional). Connect to a ground (through a momentary switch) to enable launch (when pressed).
- Pink/Green - Ignition output C
- Pink/Black - ignition output D
- Orange/Green – SPARE_ADC analog input, 0-5V sensor. Resistive sensors can be used by using the internal jumper, which activates a 2490Ω pull-up resistor.
- Orange/Red – EGO2 analog input, 0-5V sensor. Resistive sensors can be used by using the internal jumper, which activates a 2490Ω pull-up resistor.
- Yellow/Blue – VVT control solenoid (negative side) to use on 01-05 engine swaps. The other pin of the valve needs a switched and fused (5A) 12V power supply. The valve does not have a polarity.
- Yellow/White - Boost control output. Connect this to a boost control valve. The other wire of the boost control valve needs to be connected to a switched and fused 12V source. A 5A fuse is recommended.
- White (optional; not available on the 99-05 as the signal is already routed through the stock harness) – Knock input. Connect to a knock sensor.
- Grey/Brown – Nitrous_In digital on/off input. Connect this to a ground through an on/off switch. Can be used to activate/deactivate features. (ie traction control, nitrous, etc).
- Yellow/Grey - Free programmable output (Nitrous 2), low side. Can drive any load up to 2A.
- Yellow/Brown - Free programmable output (FIDLE), low side. Can drive any load up to 2A.

- **Complete pinout for the DB-37 connector on the rear of the ECU:**

| Pin	Function	Description	Color		
1	Fused 12V Out	Convenient 12V supply for a wideband. Fused at 6A,			
2	Device ground	Convenient ground supply for accessories			
3	Analog ground	Ground for analog sensors. Do not connect loads.			
4	Analog wideband input	0-5V analog input from a wideband. 5V max.			
5	External MAP input	For use with external MAP sensors (jumper inside)			
6	Spark output C	Sequential spark output C			
7	Spark output D	Sequential spark output D			
8	CANH	CAN Bus High (+) Connection			
9	CANL	CAN Bus Low (-) Connection			
10	RPM Out	RPM (tach) signal for accessories			
11	EXT_MAP Analog Input	Used internally by baro sensor (which can be deactivated)			
12	SPARE_ADC Analog Input	Spare analog (0-5V) input			
13	PT2 On/Off Input	Spare digital (on/off) input (5V max!)			
14	Tableswitch On/Off Input	Spare digital (on/off) input (14V max!)			
15	Launch In On/Off Input	Spare digital (on/off) input (14V max!). **90-00 only.**			
16	EGO2 Analog Input	Spare analog (0-5V) input			
17	VSS1 (PE0)	Spare frequency input. **90-97 only.**			
18	IAC1 Programmable Output	Programmable low-side output (500mA max)			
19	Nitrous2 Programmable Output	Programmable low-side output			
20	EBC Output (Boost)	Electronic boost control output			
21	Device ground	Convenient ground supply for accessories	--	--	--
22	--	--	--	--	--
23	Nitrous_In On/Off Input	Spare digital (on/off) input (14V max!)			
24	--	--	--	--	--
25	ADC7/JS4 Analog Input	Spare analog (0-5V) input			
26	Flex sensor input (FLEX)	Frequency input for flex fuel sensors (50-150Hz)			
27	VSS2 (PE1)	Spare frequency input			
28	--	--	--	--	--
29	--	--	--	--	--
30	Battery light output (PB7)	Programmable low-side output (300mA max). **90-97 only.**			
31	ADC6/JS5 Analog Input	Spare analog (0-5V) input			
32	--	--	--	--	--
33	DSP Knock Input	Knock(+) sensor input. **90-97 only.**			
34	Alternator output (IAC2)	Alternator field control signal output. **90-97 only.**			
35	5V Out	5V supply for sensors			
36	VVT Output	VVT(-) control output. **90-99 only.**			
37	FIDLE Programmable Output	Programmable low-side output			

Notes: 1) Pins numbers are labeled on the connector if you look closely.
2) All generic programmable <u>outputs</u> are Yellow/X.
3) All <u>digital inputs</u> are Grey/X
4) All generic <u>analog inputs</u> are Orange/X

- **Jumper Settings:**
  - **90-93 1.6L with stock batch injection:**
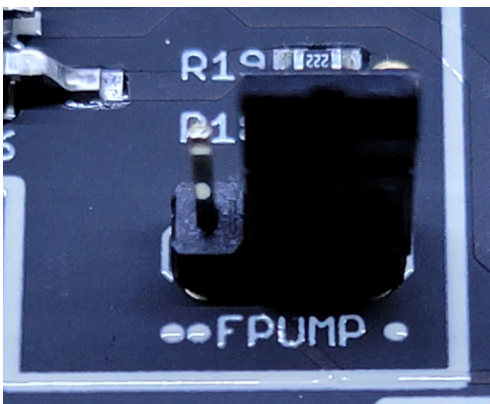
  Jumpers for TPS, tachometer output (RPM signal for cluster), CAS, 5V
  output for TPS, fan control output:
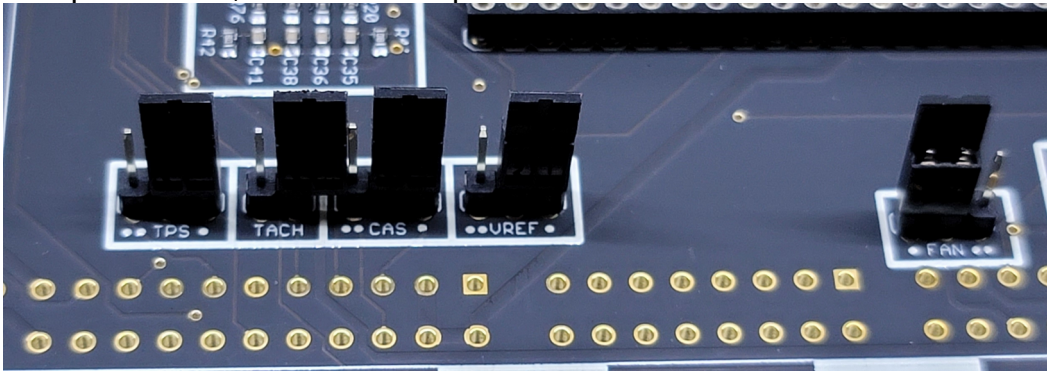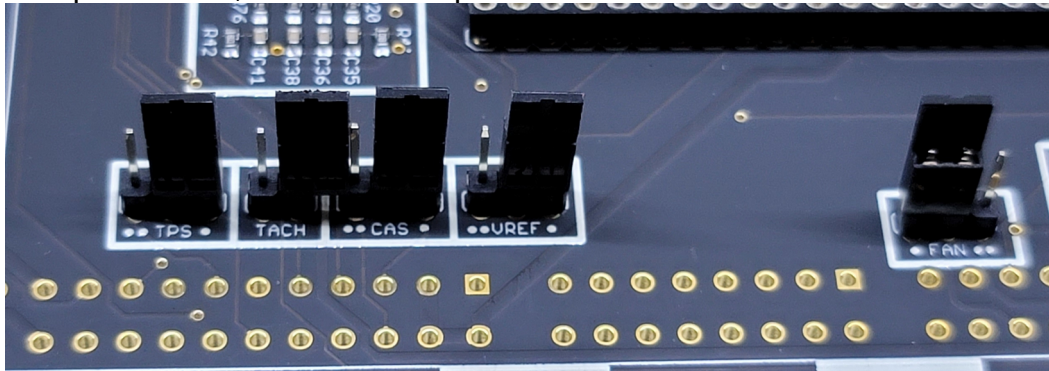

  Jumpers for batch injection:
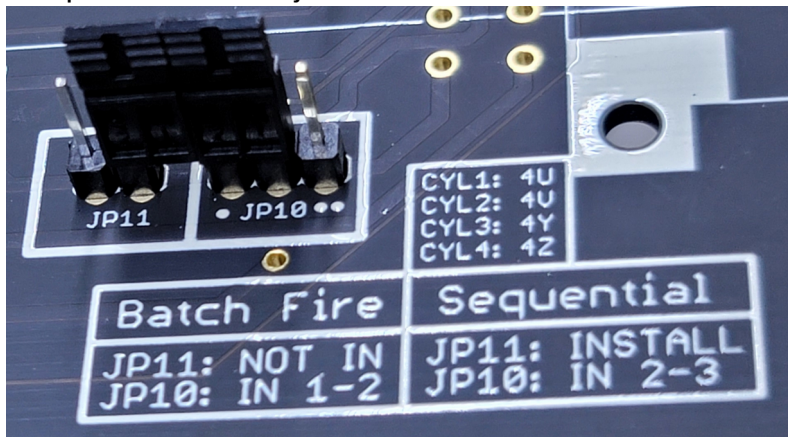
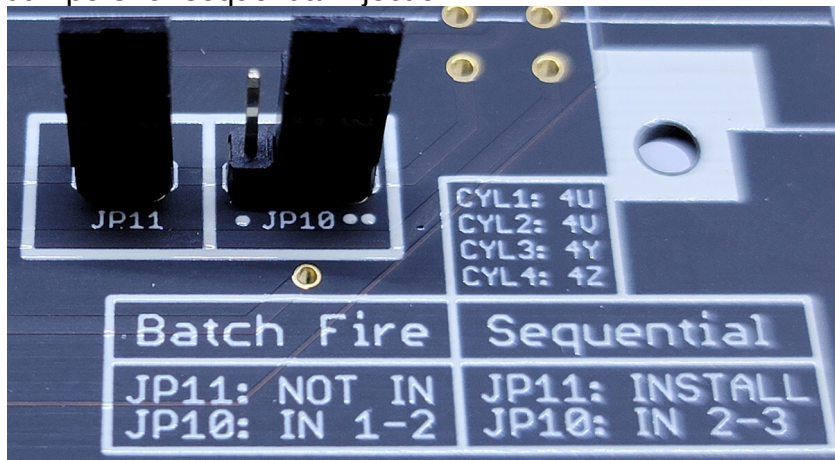 Jumper for fuel pump control (Remove the STSIGN fuse!):

- **Jumper Settings:**
    - **90-93 1.6L with sequential injection (modified wiring or California spec):**
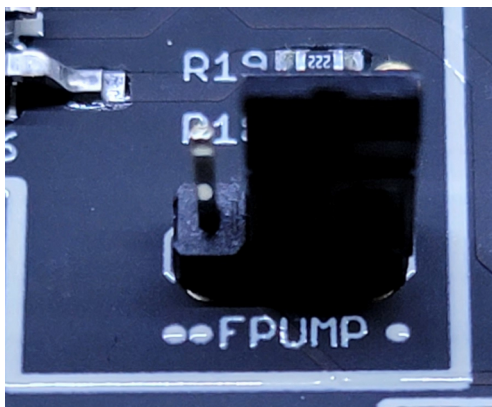
Jumpers for TPS, tachometer output (RPM signal for cluster), CAS, 5V
output for TPS, fan control output:

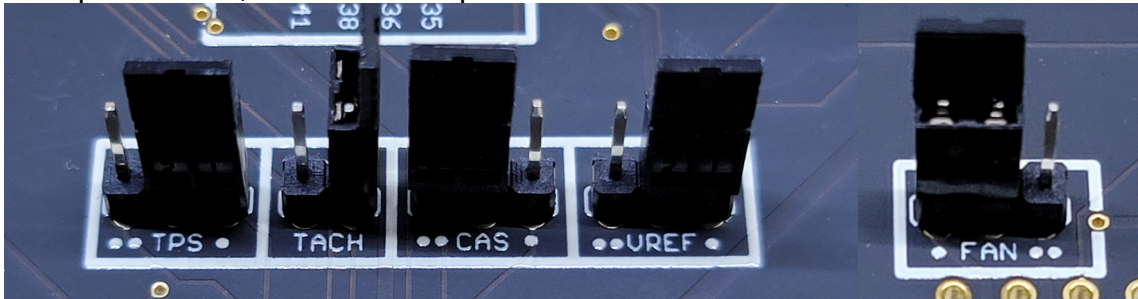Jumpers for sequential injection:

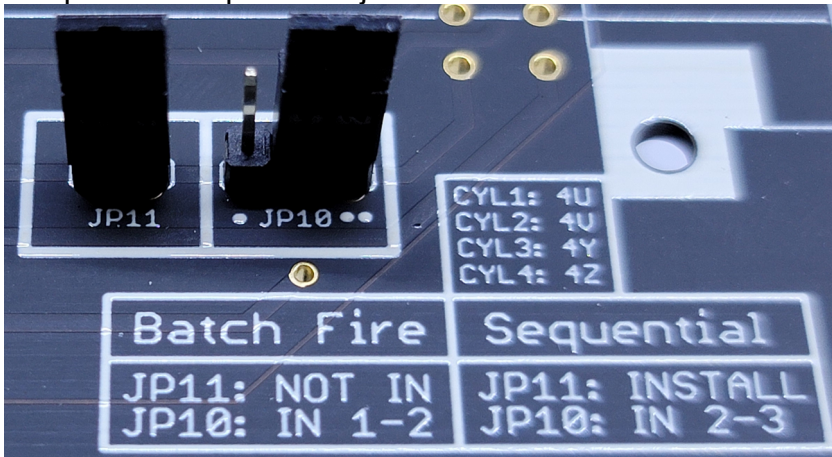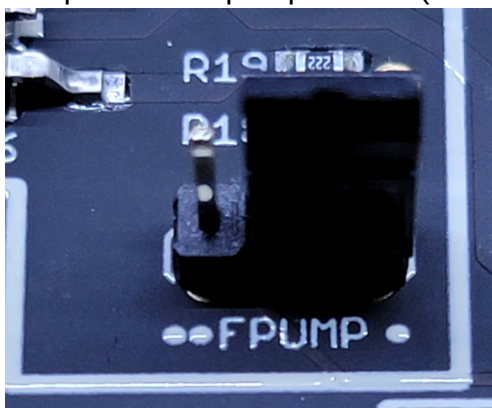Jumper for fuel pump control (Remove the STSIGN fuse!):

- **Jumper Settings:**
  - **94-97 1.6L with sequential injection and immobilizer:**

    Jumpers for TPS, tachometer output (RPM signal for cluster), CAS, 5V
      output for TPS, fan control output:

    Jumpers for sequential injection:
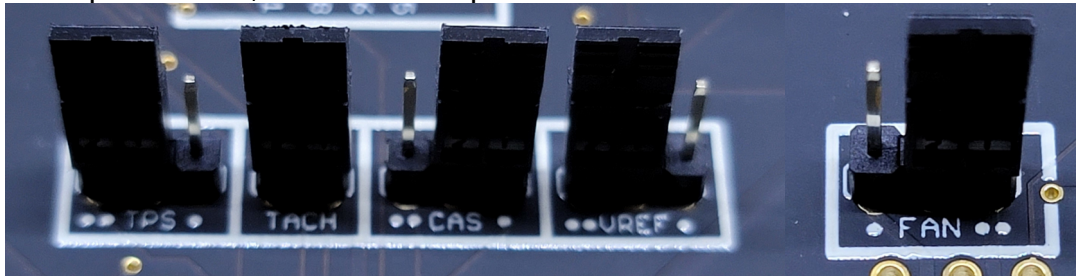

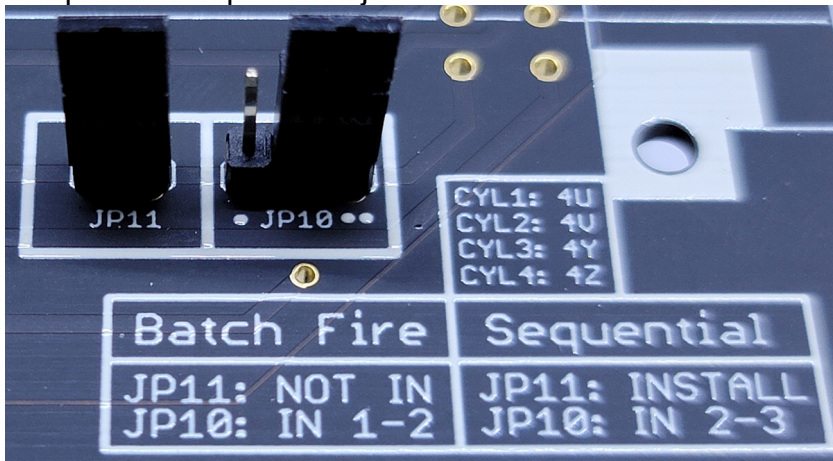   Jumper for fuel pump control (Remove the STSIGN fuse!):

- **Jumper Settings:**
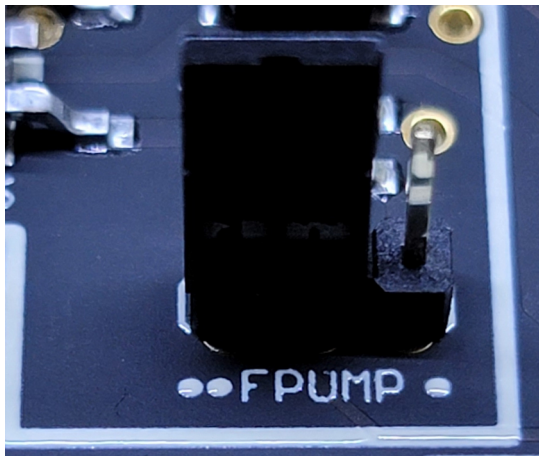 - **94-95 1.8L:**

    Jumpers for TPS, tachometer output (RPM signal for cluster), CAS, 5V output for TPS, fan control output:

    Jumpers for sequential injection:

    Jumper for fuel pump control:

- **<u>Setting the base timing:</u>**
    - Run TunerStudio and open your project
    - Make sure you are in Online mode
    - Go to Ignition Settings -> Ignition Options/Wheel Decoder
    - Set "Fixed Advance" to "Fixed Timing"
    - Set "Timing for Fixed Advanced" to "10".
    - Click Burn
    - The crank pulley on the 99-05 has two marks on it. The left mark should align with the "10" sign just behing the pulley, while the right mark should align with the "T" mark behind the pulley. On the 90-97, there is only one mark, which should align with the "10" mark.
    - Go to Tools -> Trigger Wizard
    - Press the "-" and "+" buttons until both marks on the pulley are properly aligned. On the 90-97, there is only mark, so that should align with "10".
    - Press Burn when you are done.
    - Go to Ignition Settings -> Ignition Options/Wheel Decoder
    - Set "Fixed Advance" back to "Use Table" and click Burn
    - The base timing is now set properly!

    <u>You are now ready to start the car and tune!</u>

- **<u>Basic considerations for autotune ("VE Analyze Live" aka VEAL)</u>**
    - Don't let VEAL autotune your idle – in most cases you will get a hunting (oscillating) idle as if your car has aggressive cams. To fix this, go to "VE Analyze Live" → Advanced Settings ->Min RPM and set it to 1500rpm.
    - VEAL also likes to pull fuel on the very low load areas and as a result, after autotuning for a while the car may hesisate at very low loads. To fix this, go to "VE Analyze Live" → Advanced Settings ->Min fuelload and set it to 30kPa.
    - For the first 20 minutes of autotuning, set "Cell Change Resistance" to "Easy" to get some quick results. Then set it back to "Normal".
    - As you go along and you are happy with the results, increase the Resistance setting above even more.
    - To get good results with VEAL, you need to drive VERY smoothly, as if you were driving on ice. This means very smooth transitions on the throttle.
    - Make sure you sweep all areas of the fuel map by setting a fuel load target (adjust your right foot on the throttle so the fuel load remains constant while driving) then sweep through the entire RPM range up to the rev limiter. For example, try to achieve a constant 50% fuel load with the throttle while the RPMs increase. Repeat as many times needed for this particular fuel load target.
    - Start from 40% and increase the fuel load target by 10% each time, until your maximum achievable fuel load has been reached.
    - If you can't reach the rev limiter with very low fuel loads (ie 40%, 50%), use a lower gear (1st, 2$^{nd, etc}$).
    - Keep your eye on the AFR gauge – if it is too lean (especially under load) step off the throttle and add some fuel manually to the map before proceeding any further!
    - Make sure "Update Controller" is enabled.
    - Click "Burn" every 5 minutes to make sure you don't lose any progress if your laptop dies of battery or crashes, etc.