ECUMaster EMU First Start Checklist

After installation and following through to the end of the "EMU First Start Checklist" document, see the "*FAQ and Troubleshooting*" document for much more information on frequently asked questions such as initial fuel tuning of the EMU Black "advanced fueling" strategy, idle tuning, troubleshooting diagnostics help, settings, and more. *FAQ AND TROUBLESHOOTING DOCUMENT*

Installation and important information to get started

Disconnect negative terminal of battery before installation of the EMU

Unpack EMU and plug and play adapter. Using the included printout, verify input and output wiring on plug and play harness.

Remove any panels necessary to access the factory ECU and remove the factory computer. Remove fuses for ignition coils and injectors (crank and cam signal must be verified before connecting coils and injectors).

Connect the plug and play adapter to the vehicle's engine harness and connect the EMU to the other side of the plug and play harness. Run an 1/8" to 3/16" vacuum hose to the MAP sensor port on the EMU (located between the black and gray connectors). Route and secure the line in such a manner as to prevent pinching or chafing. Vacuum source must be from the intake manifold, located after the throttle inlet.
Warning: Confirm the port used from the intake manifold IS NOT A COOLANT PORT.

EMU Black B13 constant battery connection: Pin B13 Constant Battery must be connected for EMU Black to function correctly. It should be connected to a fused 12 volts. A 10-amp fuse can be used if a DBW throttle body will be used with the EMU Black, otherwise, a 3 to 5 amp fuse may be used.
A common question we get is, *"Can B13 be connected to a switched relay?"*. B13 can connect through a relay controlled by switched ignition if the *[Delayed Turn Off]* feature will not be used.
*Tech Note: **When B13 is connected with G18 switched 12v instead of directly to the battery, this may result with the EMU Black not powering off after "Key off" on some vehicles**. Wire B13 correctly if this occurs. If the problem persists, see "Troubleshooting notes" at the end of the document for more help.*

At this point, route any wiring necessary for additional sensors such as Flex Fuel, fuel pressure, oil pressure, wideband O_2, etc.

Power Grounds: All "Power Ground" terminals must connect to ground for the EMU outputs to function correctly. Power Ground terminals supply the ground feed to all ground outputs

ECUMaster EMU First Start Checklist

which include Injector outputs, Ignition outputs (to passive coils without amplifiers), Aux outputs, and the ground side of the H-Bridge/Stepper output circuits.
Each Power Ground should run to a good grounding location. The engine cylinder head or block is a preferred location.

ECU Ground: The ECU Ground can connect to the cylinder head, engine block, or chassis ground. This must be connected for the EMU to function correctly when power is applied to the EMU.

Sensor Ground: Ground only used to connect to a sensor's ground terminal. This ground does not connect to the chassis or engine block.

About the EMU Inputs:

-**Analog Inputs** can be used for:
(3 wire) 0-5v sensors
(2 wire) temperature sensors
Switch/Button inputs to ground (with a pullup resistor to 5v)
Switch/Button inputs to 5v (with a pulldown resistor to Sensor Ground)

-**Switch#1, 2, and 3 Inputs (EMU Black only):**
Switch/Button inputs. One switch/button terminal **must connect to Sensor Ground only**, the other switch/button terminal connects to **Switch #1, 2, or 3** In. Note: Using chassis ground or power ground as a reference will make Switch inputs unstable.
-**Flex Fuel input (EMU Black only):** (Frequently asked)
Connect to sensor **Vout**. (EMU Classic only: connect **Vout** to **CAMSYNC #2**)
Sensor **Vcc**- Switched 12 volts (from any key switched 12-volt source)
Sensor **GND**- Can connect to engine ground, chassis ground, or EMU sensor ground

Critical Inputs:
-**CLT In:** One coolant sensor terminal to CLT In. One sensor terminal to Sensor Ground.
-**IAT In:** One coolant sensor terminal to IAT In. One sensor terminal to Sensor Ground.
-**Primary trigger:** One primary (crank or CAS) sensor terminal to Primary trigger In. One sensor terminal to Sensor Ground.
-**Camsync#1 and #2:** One secondary (cam or CAS) sensor terminal. One sensor terminal to Sensor Ground.

About the EMU Outputs:
Power Grounds must be connected for all grounded outputs to function! (See "Power Grounds:" above for more information.)

ECUMaster EMU First Start Checklist

-All **AUX #1-AUX #6** outputs are (-) Negative/Ground when active.

-**Injector** outputs are (-) Negative/Ground. Switched 12v supply must be connected to the other injector terminal.

-**Ignition Outputs** see **"Initial Engine Displacement, Injector Settings, and Ignition Coil Settings".**

-EMU Black **H-Bridge** or EMU Classic **Stepper** outputs are bi-polar which can be (-) Negative/Ground or 12 volts depending on when they are active or not active. "Invert Output" check mark in the output assignment parameters can be checked or unchecked to make these outputs Ground or 12v when active.

2 wire solenoid wiring:

Most all 2 wire solenoid wiring including Boost, VVT, and Idle valves. **For EMU Classic**, **diode PN: 1N4007** should be installed (parallel) bridged between the switched 12v wire to the Aux output wire when a PWM/Duty Cycle% signals are applied. (Diode band facing toward 12v wire. **For EMU Black**, **diode PN: 1N4007** will only be required when PWM solenoids or injectors are connected to Aux #1 and Aux#2. Aux#3 through Aux#6 have built-in diodes.

-AUX output (or H-Bridge/Stepper output set to "Inverted") from EMU to one solenoid terminal

-Switched 12v to other solenoid terminal

Note: Honda is an exception on some factory solenoids such as VVT and VTEC solenoids. These may be grounded in the harness and 12v from a relay or H-Bridge output may need to be applied to function. **Always check factory wiring diagrams before wiring an EMU.**

Tech Note: Honda VTec we have worked with require a 12v signal from the ECU to activate the solenoid. An EMU Black H-Bridge output or EMU Classic Stepper output can be used since they are bi-polar (12v or Ground).

Wideband O2 Sensor wiring to EMU:

(Note for 4.2 or 4.9 wideband O2 sensor: Do not splice into any WBO wires between the EMU and PnP adapter or it can result in damage to the wideband sensor!)

Click here for the Bosch O2 sensor installation pinout diagrams: O2 Sensor Installation Diagrams

When wiring a 4.2 or 4.9 wideband sensor, be sure to remove any wire connected between the EMU "WBO" terminals and the PnP adapter (if adapter installed). All wideband wires will only terminate directly to the EMU connector. The only wire that can be professionally tapped is the switched WBO +12 volt Heater (fused) wire from the sensor.

(Bosch 4.2 sensor note for the EMU Classic only): Before installing a 4.2 wideband O_2 sensor directly to an EMU Classic, use a multimeter to measure the calibration resistor value across pins 2 and 6. Resistance should be in the range of 80-200 Ohms. Write this number down, as it

will need to be entered in the software after the EMU is powered up.) See "**Configuring a Wideband O2 Sensor (Lambda Sensor):**" for configuring O2/Lambda sensor.

External O2 sensor controller: If using an external O2 sensor gauge controller with a 0v to 5v (+) analog output, the (+) analog output should be connected to an available EMU **"analog input"** channel and assigned in the Oxygen Sensor parameters in the "Sensor Setup" menu, then set the voltage calibration per the external controller's *voltage vs AFR* specifications from the manufacturer's manual.

Connect the external O2 sensor controller Sensor Ground (or 0v reference wire) to the EMU Sensor Ground. See "***Using an External Wideband Controller like an AEM gauge***" in this document on page 13 for configuring an external controller input in the EMU Client.

Caution: To prevent damage to the EMU or the external controller, please refer to the external O2 sensor documentation or the manufacturer of the device to ensure if the controller has an analog output for this purpose before making any connection.

Note on Grounding: Connecting analog voltage outputs to analog voltage inputs from different controllers can present ground issues or differences causing fluctuating voltages which may be unavoidable with some configurations. If any fluctuation issues are observed between the readings from the external controller gauge and the EMU Lambda/AFR reading after the engine is running, check again if the Oxygen Sensor analog voltage calibration values are correct or connect the external controller main ground to the same ground to the same ground as the EMU if it is not already connected this way.

Example, if the EMU is grounded from the engine block, connect the main ground from the external controller to the engine block. If the device has an analog out sensor ground, it may cause this type of ground issue if connected to the EMU Sensor Ground. If connected, try removing the external controller sensor ground from the EMU sensor ground to observe if the issue still exists.

DO NOT CONNECT THE EXTERNAL CONTROLLER'S MAIN POWER GROUND TO THE EMU "SENSOR GROUND" TERMINAL.

Sensors, Software, and Firmware:

After all sensors are installed, connect the included USB cable to both the EMU and your laptop. Ensure that you have downloaded the latest released software and drivers from https://www.ecumaster.com/download.

-For BETA firmware:

The latest BETA versions can be downloaded from

http://www.ecumaster.com/testVersions.html**.**

-Updating EMU firmware:

ECUMaster EMU First Start Checklist

EMU Firmware can be updated by connecting the laptop to the EMU, powering on, clicking "*File/Upgrade Firmware...*" in the EMU Client, then selecting the newest version Firmware file with the highest number unless an older BETA FW version is required.
-Location of Project files (base maps):
Project Files (base maps) are located in the "Base Maps and Manuals" drive link at the bottom of the ECUMaster USA Downloads page [https://ecumasterusa.com/pages/software-downloads page](https://ecumasterusa.com/pages/software-downloads).

Note: if using a <u>Wiring Specialties</u> or other aftermarket harness built to connect directly to the EMU, download a Project File (base map) that closely matches your engine configuration. Before uploading the base map into the EMU, open the base map and <u>use the input/output assignment sheet that is supplied with the harness to change the inputs and outputs in the base map then "*Save Project As*" a new Project File</u>.
You can see the Inputs and Outputs already assigned in a base map by clicking "Tools" at the top of the EMU Client, then select "Show Assigned Inputs" or "Show Assigned Outputs". This also shows the path to find each feature to which they are assigned. Only one of these windows can be opened at a time and must be closed before continuing to assign I/O.

After verifying that the power for the coils and injectors has been disconnected (by removing fuses or relays or simply unplugging the connectors at the injectors and coils), reconnect the negative battery terminal, open the EMU software on your laptop, and turn the ignition key to the "ON" position. In the lower left corner of the EMU screen, the connection status box should change from a flashing red "<mark style="background-color:red">Disconnected</mark>" indicator, to a solid green "<mark style="background-color:green">Connected</mark>" indicator.

Loading a Base Map and <mark style="background-color:yellow">Warning Window</mark>:
Verify that the correct map is loaded in the EMU. To load a map, go to "File", "Open Project" and select the correct file from your computer.
If a Warning window appears in the upper left of the EMU Client window stating the Project File was created using a higher firmware version: This is only showing the extra data that is different from the software/firmware revision currently on your laptop or EMU device. You can **click "OK" to continue loading the selected Project File and the Project File will successfully load.** You can update the Firmware to the report revision if necessary.
If the *EMU Client SHUTS DOWN* after clicking "OK" to a warning window that opens in the *center* of the EMU Client window stating that the EMU Client must be updated: Visit ***http://www.ecumaster.com/testVersions.html*** to download and install the newest Beta version of the EMU Client higher than the released FW version 2.113. (see **Sensors, Software**

and Firmware above). After opening and proceeding to write the project file to the EMU device, press [F2] to Make Permanent or changes will be lost when the key is turned off. Proceed to set up all the outputs and inputs correctly.

Important note for "Import EMU Project" Classic file into EMU Black:

There are differences between the Classic and Black files to check and correct when importing a Classic project file into the EMU Black. Check the path locations to the settings below for these values:

- **Fueling/Fuel Tables/Lambda Trgt.#1 and #2** - If any Lambda value in the tables show "1.47", then follow these steps

      1. Left click mouse and drag diagonally across cells to highlight all the cells in the Lambda table.

      2. Type the following exactly: 1.47/

      3. Press <ENTER>.

      4. Verify that any cells showing "1.47" now show "1.00".

- **Ignition/Triggers/Primary and Secondary Trigger Tables** - Pullup values are "Pullup 4K7"

      "Pullup 820 Ohm" works best with the Nissan CAS configuration.

      The 820 Ohm pullup may help with other configurations converting from Classic to Black as well.

-**Engine start/Parameters/"Use Injector cal." -** Verify "Use Injector Cal." is enabled so the EMU can add the "Inj Cal." deadtime or offset values into the fueling calculation.

-**Sensor calibration - IAT and CLT will convert correctly**, though it is best to verify. Most alternate sensor calibration tables like **Oil Psi** and **Fuel Psi** tables, for example, are a different resolution in the Black Client. These psi sensors are normally linear calibration values, so they have been reduced to simple (2) or (4) cells. Check and re-calibrate all alternate sensor calibration tables after conversion.

-**Boost Parameters** - [Boost Parameters] settings convert correctly, though extra settings options were added which should be verified. [Boost Ref DC] and [Boost Target] tables are required to be copied from the Classic to the Black tables.

More settings may not carry over with future firmware improvements. Please check all parameters and tables to confirm it matches your configuration.

Parameters Panel (Tuning Menu Panel - Left Menu Window):

The *Parameters Panel* on the left side of the screen in the EMU Client software shows all of the Tuning Parameters settings and Tuning Tables to tune the engine.

The left **Parameters Panel size** depends on the Windows display resolution settings. If the panel is not wide enough, click the ⚒ **Configuration button** at the top of the Client to increase **"Parameters Panel Size"**. Maximum is **"300"**. You can change the resolution of your display if it needs to be wider.

ECUMaster EMU First Start Checklist

Tip: Toggle the function button <F9> to make this window hidden or visible.

Necessary Step, Graph Log and Scope Log:
In the left parameters menu window of the EMU Client software, expand "Log" and select "Graph 1" and "Scope". These (2) log windows are the most important when first trying to start an engine!
The selected visible parameters and all unselected parameters are logged in the Graph 1 Log.

To Save A Graph Log or Scope log:
Click the 💾 icon in the upper left of Graph 1 Log window or the "Scope" window to save the Graph or Scope logs to email. The extension of a Graph Log is ".emublog" for EMU Black and ".emulog" for EMU Classic. The extension for the Scope log is ".emubscp" for EMU Black and ".emuscp" for EMU Classic.
Default save location is under Documents/EMU Black/<SN of the EMU unit folder> or Documents/EMU Classic/<SN of the EMU unit folder>. Save this in a more accessible folder location if desired.

<u>**The saved Graph Log, saved Scope Log, and saved Project file (also called map or tune) must be attached and included in an email to Support@ecumasterusa.com if you have an issue. Please go over any issue a few times before emailing the issue. Most issues can normally be resolved more quickly by stopping to consider all possible reasons that can cause the problem before initially concluding a hardware failure exists.**</u>

   Graph Log - is a tool used to analyze engine performance and the device state of the ECUMASTER EMU. Data is shown as a linear graph as a function of time, with time represented on the lower axis. Detailed information about the exact value of a particular channel can be displayed by using the cursor to select a point on the graph, then data related to that exact point will be shown. This logging tool is of key importance when creating an engine calibration, as well as for troubleshooting. <u>More info can be found in the "?" help button in the Graph Log window.</u>

   Scope - is a built-in scope tool that allows you to measure signals present at *primary trigger*, *CAM#1* and *CAM#2* inputs. This will be a necessary tool if you have trouble starting an engine. Using this tool, it is possible to determine the trigger pattern for crankshaft and camshafts trigger wheels, check if the polarity of the signal is correct, and save the trace for further analysis or for technical support for troubleshooting.

ECUMaster EMU First Start Checklist

To record a log, a signal at *primary trigger* input is required. To activate the scope functionality, the option *enable scope* needs to be checked in the Primary trigger configuration window. The scope tool is available in log/Scope options.

The "**Trigger Scope Procedure for testing trigger settings:**" on page 9 will take you through the procedure for using the Scope.
More info can be found in the "?" help button in the Scope Log window.

TPS Calibration:

From the tuning menu in the left window panel of the EMU Client, expand "Sensors setup" and select "TPS" parameters (used to input TPS calibration voltage). Then, expand "Log" and select "Analog Inputs" to see "TPS Voltage" (used to view the TPS voltage). Press <F9> to toggle the tuning menu if the left Parameters Panel is not visible.
With the throttle plate closed, input the "TPS min voltage".
With the Throttle plate fully open, input the "TPS max voltage".
Press <F2> to Make Permanent or click the "Make Permanent" button (the upper left chip button seen directly below "File").
TPS Notes:
This and more information can be seen in the "?" Help file under the TPS Setup window.
If you are using an alternate TPS that has inverted signals (high voltage when closed and lower voltage when fully open, the same procedure will be used.
If the TPS voltage does not move in the "Analog Inputs" log window when the throttle is pressed, the wiring will need to be checked if 5 volts, TPS signal, and Signal ground is terminated correctly or for failure of the Throttle Position Sensor.

Initial Engine Displacement, Injector Settings, and Ignition Coil Settings:

These are very important for initial setup in the EMU Client. Below are the locations of these settings. Select the 🔵 Icon in the windows for more information on the settings.
ECUMaster Base maps will normally have the correct information already set for unmodified OEM configuration, though injector size may be different in some cases so please check.
Engine Displacement, Injector size, and Fueling Type - **_"General"_** settings window under **_"Fueling"_**.
If your injectors have flow vs fuel psi specifications, match the size with your static set fuel psi.
Injector Offset or Deadtime - **_"Injectors Cal"_** table under **_"Fueling/Injectors"_** (Black) **_"Fueling"_** (Classic).
Injector Deadtime or Offset vs Battery Volts is entered here if specifications are available.
If stock injectors are used, 1.0ms at 12v is fine for most stock injectors. To include the injector

offset data in the fueling calculations, put a checkmark in the *"Use injectors cal"* box under *"Engine Start/Parameters".*

Coil Type (Logic "Smart", Passive "Dumb" and Firing Order - *"Ignition Outputs"* settings under *"Ignition/Coils"*.

Note: Damage to coils and ignition drivers can occur If the *"Coils Type"* setting is not correct. Please research to ensure what coils type you have. There are two choices below.

"Coils without amplifiers"-(Direct control of Passive/Dumb coils without Igniter) This is known as a **low side** trigger. This setting is used when a stock igniter is not present or has been removed. This is used when ignition outputs have been wired directly to (2) wire and some (3) wire "**Passive or (Dumb)**" ignition coils. Examples of passive coils and when this may need to be set:

(2) wire coils

-Some early SR20 (3) wire Nissan coils (When ignitor bypassed and coil connected directly to EMU)

-Some (3) wire BMW coils

When aftermarket wiring harnesses, (like Wiring Specialties, Tweak'd Performance harnesses), are made to bypass a stock igniter. **It is important to check with the harness manufacturer first before connecting coils!**

"Coils with built in amplifier"-(Stock Igniter, Logic/Smart coils) This setting is used mostly with stock (unmodified) wire harnesses when ignition outputs are connected to a stock igniter and the igniter fires the coils.

Also used when connected to (3), (4), or (5) wire "**Active**" or (**Smart)**" coils that have a "Built in" amplifier which requires a positive voltage to trigger a coil known as **logic trigger or high side trigger**.

Warning: Beware when installing aftermarket wire harnesses! Ask the manufacturer if the harness uses the stock igniter or bypasses the stock igniter and set accordingly.

If the setting is incorrect, ignition coils will get melting hot and both the ignition coils and the EMU ignition drivers can be damaged!

Test Outputs:

This tool is located at the top of the EMU Client under *Tools/Test Outputs*. The engine will not run when certain components such as relays, injectors, and ignition coils do not function properly. This tool is used to test all Aux, H-Bridge, Stepper, Injector, and Ignition outputs to verify they function correctly before trying to start the engine. *Test Outputs* will send a pulsed On/Off signal to the components and has an "On Time" and "Off Time" milliseconds value that can be adjusted if necessary. Test all outputs before moving onto the Trigger *"Scope"*.

DISCONNECT THE FUEL PUMP POWER OR DISABLE THE FUEL PUMP IN THE *"OUTPUTS"* **SECTION BEFORE TESTING THE INJECTOR OUTPUTS TO PREVENT FLOODING THE ENGINE WITH**

ECUMaster EMU First Start Checklist

FUEL. The <u>Fuel Pump or Fuel Pump Relay</u> can be reconnected and tested last after the injectors have been tested.

Trigger Scope Procedure for testing trigger settings:
After verifying all inputs/outputs, ignition trigger settings, coil settings (active/passive coils), sensor settings, and injector settings, you are ready to test the cam and crank signals (again, do this with the coils and injectors disconnected). Under the Ignition menu, go to "*Primary Trigger*" and ensure that the "*Enable Scope*" box is selected. Then under the "Log" menu on the left-hand side, open the "*Scope*" log feature. The scope feature will record trigger events as seen by the EMU. Once the *Scope* window is open, follow the steps below.

1. <u>PRESS and **HOLD**</u> the blue arrow .

2. Activate the starter to crank over the engine while continuing to hold the blue arrow button. Let the engine crank over for about **<u>4 seconds</u>**.

3. When the 4 seconds have passed, release the blue arrow **<u>first</u>**, then release the key to stop cranking the engine.

The trigger log data lines will appear and you should see a Primary trigger pattern that matches the number of teeth on the crank trigger wheel (or Distributor wheel), and Secondary trigger pattern that matches the Cam teeth patterns (or Distributor wheel). If the cam and crank signals read correctly you are ready to move on. Verify ignition coil and dwell settings one last time and then connect the power supply to the coils.

Trigger Troubleshooting:
1. If there are no Primary or Secondary lines, please try this procedure again exactly as it is stated in the   steps. The timing in the procedure is necessary for the best results.
2. If you are not getting one or both triggers while running a ECUMaster PnP adapter on an engine with a Distributor (**2JZ-GE or 3SGTE** for example), some adapters, like the MK4 Supra unit, have trigger resistors that can make a Distributor signal weak. If you measure resistance between the EMU pin and the OEM Primary or Secondary terminals, you may need to simply remove the Primary and/or the Secondary wires from the OEM ECU connector to wire them directly into the EMU connector to bypass the adapter. Then try the Scope again.
3. If you have a **Nissan S13/S14A or S15 configured 64 pin adapter**, no scope trigger lines may be present and no power to the coils when using "Test Outputs". The ECCS Relay activation is required to provide power to the CAS (Cam Angle Sensor) and the ignition coils. Click this

ECUMaster EMU First Start Checklist

document link "Nissan SR20 S13 64 Pin Adapter and 62/63/E5 Conversion" for instructions on your specific stock ECU model number.

Using the Timing Light after verifying correct Trigger data from Scope:
 Expand the "**Ignition**" menu for the "Primary Trigger" parameters in the EMU Client Menu Panel on the left of the screen.
For EMU Black, it is under Ignition/Triggers/Primary Trigger.
For EMU Classic, it is under Ignition/Primary Trigger.
Enable the "**Ignition Angle Lock**" feature in the Primary Trigger parameter window. The "**Locked Angl**e" value can be set to any Degree number that is visible on the TDC (Top Dead Center) Timing Indicator mark located directly above the crank pulley. Usually, 0, 10, or 15 deg marks will be visible. Ensure that the mark on the crank pulley is cleaned for visibility. It helps to carefully apply a very bright narrow white or neon colored paint to make the mark more visible. (If no TDC indicator is visible and no spark plug wires are installed, see "Note" below procedure).

Please refer to the manual or manufacturer of timing light for correct setup and usage.

Connect the timing light, activate the starter to start cranking the engine, use the timing light to verify the timing mark on crank pulley lines up with the degree angle indicator mark that was used for the "**Locked Angle**" value.
If timing marks do not line up, "**Trigger Angle**", "**First Trigger Tooth**", or "**Ignition Offset**" adjustments are required.
Tip: If the timing light does not light up when cranking the engine over:
1. Use "Test Outputs" under "Tools" to trigger "Ignition Output #1" to check if the timing light will flash. If not, unclamp the timing light clamp from the wire, rotate the clamp 180 degrees and clamp it on from
2. Verify the Graph log shows RPM and a solid [Cam Sync Trigger Tooth] value.
3. Verify

First Trigger Tooth - Rotates the crank pulley TDC mark clockwise or counter clockwise the degree angle of each tooth.
Example,.. if it has a 36-2 crank wheel, calculate 360 degrees divided by the number of teeth. (360/36=10 degrees). Each first tooth trigger change with this wheel rotates the TDC timing mark 10 degrees clockwise or counter clockwise.

Trigger Angle = Rotates the crank pulley TDC mark clockwise or counter clockwise 1 degree for each single degree change. The best suggestion

ECUMaster EMU First Start Checklist

Output Offset (found in "**Ignition/Ignition Outputs**") = Rotates the crank pulley TDC mark clockwise or counter clockwise to fire the next cylinder first represented in the Firing Order. Example,.. if the timing light is on Cyl 1 on a 4 cylinder, firing order 1-3-4-2, and the TDC mark on the crank pulley is pointing to the ground when the light fires (180 degrees where it should be), then the triggering could be trying to to fire cyl 3 first instead of cyl 1. This can be caused by the First Tooth value or is sometimes not avoidable due to some trigger systems. It's ok…
If this is the case, Output Offset value can be changed from Offset 0 (firing cyl 1 first 1-3-4-2) to Offset 1 (firing cyl 3 first 3-4-2-1) which is the same firing order with cyl 3 sequenced as the first firing cylinder.
This might be fixed by First Trigger Tooth and Trigger Angle combination or it may not. Either way, it will still run as long as you are not 360 deg out (firing on cyl 4 when it should be cyl 1). This problem can be discovered by shining the timing light on the cam gears while cranking over.
In this case, the crank timing mark will be TDC at the locked degree angle, but the timing belt alignment marks on the cam gears are rotated 180 degrees out facing away from the cam timing alignment marks.
This can simply be fixed by changing Offset 0 to Offset 2 in the Ignition Output settings.

Overall, if the crank TDC mark matches the "Locked Angle" with the timing light and the cam gear timing marks line up closely, then the base timing is correct! Once base timing is set, Disable the "Locked Angle" feature. All that is left for the engine to run is air, enough fuel pressure, fuel from injectors, and ignition from coils to spark plugs.

Timing Mark Note: Some vehicles do not have this TDC indicator point or timing mark on the crank pulley from the factory. If this is the case, the engine will need to TDC accurately, a TDC pointer fabricated, and a TDC slot applied onto the crank pulley. We highly suggest hiring a professional shop or installer for this modification.

Plug Wire Note: If the coils are single coil on plug (COP) with no spark plug wire and the timing light model being used cannot is not designed to function using the coil control wiring, then cyl 1 coil will need to be lifted from spark plug and a plug wire will need to be affixed to the coil in a way in which the coil end of the plug wire is making positive connection with the spring or spark plug terminal contact in the single coil. A large amount of electrical tape has been used in the past to affix the wire to the coil.

VVT Solenoid Install: One solenoid terminal connects to switched 12v and one solenoid terminal connects to Aux Output of the EMU and requires a diode. Research the factory wiring diagram first to confirm which wire goes on which terminal since some factory solenoids may already have a diode built into the solenoid that will instantly be damaged when activated if wire polarity is backwards.

ECUMaster EMU First Start Checklist

 Install Tip: If a VVT solenoid is installed on EMU Classic Aux outputs and EMU Black Aux 1 or 2, a diode must first be installed between the Aux output wire and the switched 12v wire with the diode band facing the 12v wire. No diodes are required to be installed if connected to <u>EMU Black</u> Aux 3-6. Those outputs already have built-in diodes.

Setting Cam Angle Offset for VVT control: After the primary and secondary triggers have been confirmed, base ignition timing has been set, and the <u>engine is running</u>, you will need to view [Cam #1 Angle] in the *Graph 1 log* or *Tune Display* to adjust and verify cam angle is "0" (zero) when VVT solenoid is set to "None".

Note: [Cam #2 Angle] should be configured the same if (2) cams are being controlled through VVT. Cam angle offset will change if primary and secondary trigger settings are changed, so always check that cam angle is "0" at idle after a trigger settings change with VVT solenoid temporarily set to "None".

To adjust the [Cam #x angle] to "0":

- Expand VVT in the left Parameters Panel window in the Client,

- Open the VVT "Cam 1" or "Cam #2" parameters,

- Record which output is assigned to [Solenoid Output #] then temporarily set to "None",

- Adjust the [CAM Offset] value until [Cam Angle #1 or #2] in the log of Tune Display shows "0",

 Tuner Tip: If [Cam angle #1 or 2 Angle] shows "-500" deg when [CAM Offset] is "0", then changing [CAM Offset] to "500" should adjust [Cam #1 or #2 Angle] to "0".

- Once configured, re-assign [Solenoid Output #] to the correct previously assigned outpt channel.

All other settings in the VVT parameters must be configured per specific vehicle cam type and how that cam functions. VVT parameters are normally configured correctly on base maps.

Configuring a Wideband O2 Sensor (Lambda Sensor):

The EMU Black will control a Bosh 4.2 or 4.9 sensor. The EMU Classic can only control the Bosch 4.2.

<u>**For EMU Black**</u>, go to **"Sensor Setup/Oxygen Sensor"** to select the **Bosch 4.2** or **4.9** if a wideband sensor is directly wired to the EMU.

<u>**For EMU Classic:**</u> go to **"Sensor Setup/Oxygen Sensor"** to select the **Bosch 4.2.**

The 4.2 sensor **Rcal Ohms value** measured from sensor terminals 2 and 6**,** (covered on Page 1), is required to be entered into the **"Rcal"** field.

<u>**Using an External Wideband Controller like an AEM gauge**</u>, go to **"Sensor Setup/Oxygen Sensor"** to select the **"External Controller"** for "Sensor Type", **"Ext controller input"** select the Analog Input# channel to which the controller's analog output was connected, then set the AFR value in the AFR at 0v and AFR at 5v fields which will need to be acquired from the manufacturer of the external controller. Common values from external controllers are: 0v=10 AFR

ECUMaster EMU First Start Checklist

5v=20 AFR
<u>See Page 1-3 for wiring information.</u>

After all sensor readings, ignition timing, and outputs have been verified, connect power to the injectors and crank the engine over. If the engine does not start readily, try adjusting the injector trims up or down in 10 percent increments. Try to start with a fully charged battery. Do not crank the engine for extended periods of time, and if the engine does not start readily after a few tries, remove a spark plug to see if the plugs are wet with fuel. If the plug is wet, pull all spark plugs and allow the fuel to evaporate before starting again, this time with reduced fuel trims.

From this point forward, the EMU Client tuning software has a "?" help button in each of the parameter and table windows. These are pages from the EMU Client manual which is filled with descriptions of parameter settings and other helpful links with very useful information.

Enjoy your project!

Troubleshooting notes:
EMU power and vehicle components won't power off after Key Off: If this issue is observed, some stock or modified wiring configurations can cause this:
1. On the EMU Black, when B13 is connected with G18 or other switched 12v within the main relay instead of directly to the battery.
2.Toyota (6) wire idle stepper motors from the (2) center 12v wires in the connector causing power feedback through the H-Bridge/Stepper outputs.
3. Mazda (6) wire stepper motors on Mazda oil metering pump (OMP) on rotary engines from the (2) center 12v wires in the connector causing power feedback.
4. Nissan RB and possible SR models when an HBridge is assigned to the Fuel Pump relay (due to a component on the relay coil causing feedback voltage).

<u>Troubleshooting this issue:</u>
1. For the EMU Black, if B13 is connected with G18 or other switched 12 v within the Main Relay, remove B13 Cont Battery wire from G18 or switched 12v source to wire it correctly to the battery with a fuse.
If the problem persists after correcting, continue below.

With the key off, start disconnecting peripheral devices until the EMU powers off.
NEVER DISCONNECT THE 24 PIN OR 39 PIN EMU CONNECTORS WHEN TROUBLESHOOTING WHILE THE BATTERY IS CONNECTED! (see caution below).

ECUMaster EMU First Start Checklist

2. For the (6) pin connector- Pull the (6) pin connector from the Toyota idle motor or Mazda oil metering pump first (if installed). If the issue no longer exists, it is common to remove the (2) center 12v wires in the (6) pin connector to eliminate the problem. The H-Bridges supply the correct voltage to control this motor with the (4) H-Bridge connections.

4. For HBridge assigned relays- Some OEM relay configurations operated by assigned H-Bridges may be the cause. The relays or relay connections can be removed to check if EMU powers off. This can also be accomplished in the software by checking "Tools/Show assigned outputs" to check what output may be assigned to a specific output, going to that output and H-Bridge assignment to "None". If the EMU powers off, the relay coil may need to be re-wired. **This can be corrected** by adding a Diode inline on the HBridge circuit wire with the **Diode band facing the EMU** or unassigning the HBridge, moving that wire to an available AUX Output, and reassigning the Fuel Pump relay to the AUX Output channel.
-Possible relay activation coil configurations are-
(+) terminal of the relay coil to keyed ignition switch and H-Bridge or H-Bridge inverted output assignment.
(-) terminal of the relay coil to chassis ground and H-Bridge or H-Bridge inverted output.

 Caution on disconnecting EMU connectors while battery connected: This can cause damage to the EMU, coils, and/or cause the fuel pump to activate and injectors to open 100% which can fill the intake and cylinders with fuel until it pours out of the throttle body. Always disconnect the battery before removing the EMU connectors!
Also, disconnect the USB cable from EMU before removing EMU connectors to prevent damage to the USB port.