

# ALM-S

Accurate Lambda Meter

Manual v1.4

Check before you power on ALM-S:

- The oxygen sensor is installed in the right way (page 8); or if it's left in the free air, make sure it's dry and it's not close to the inflammable materials.
- The ALM-S is correctly connected to DC power supply or 12V battery; (page 10)

## Revision History

| <b>Data</b> | <b>Revision Level</b> | <b>Description</b>   |
|-------------|-----------------------|--|
|             | V 1.1                 | PRELIMINARY  |
| Oct 2012    | V1.2                  | 1. Updated some pictures<br>2. Updated chapter 5.2.6:Lambda analog output      |
| Oct 2012    | V1.3                  | 1. Re-numbered manual<br>2. Add analog output diagnosis capability description |
| Jan 2013    | V1.4                  | Add Chapter 7: Frequently Asked Questions                                      |

### ALM-S included parts:



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## Chapter 1 ALM-S Product Overview

ALM-S (Accurate Lambda Meter) is an air/fuel ratio (lambda) meter which uses Bosch LSU 4.9 wideband oxygen sensor and Bosch driver chip CJ125 to accurately measure the exhaust air/fuel ratio (AFR) of variant combustion engines.

ALM-S is a smaller size version of our previous ALM . It has the same accuracy and fast response characteristics like ALM, but much smaller size. The controller box has the size of 4"x2.6"x1", or similar to a business card size. It has a primary 0-5v linear analog output which can be used as the feedback control signal for an ECU. It also has an analog signal output to the 52mm digital LED gauge. The gauge is optional, because some professional tuners already have a lot of gauges which include AFR display as a part.

Further more, it has the new feature of **CAN bus** communication as optional. This is a more advanced feature for professional engine controls where CAN bus is used widely and AFR signal can be broadcasted on the CAN bus.

Our ALM uses more advanced LSU4.9 sensor instead of LSU4.2 which is still used by most other wideband controllers. LSU4.9 is the new generation wideband sensor evolving from LSU4.2. It is superior to LSU4.2 with the obvious proof: Bosch uses LSU4.9 across the board for their wideband applications. (Appendix: LSU4.9 vs LSU4.2)

CJ125 is the driver chip specifically designed by Bosch for LSU 4.9/4.2 Sensors. Bosch's own wideband controller, "Lambda Tonic", uses CJ125 driver chip. Actually Bosch uses this chip wherever the LSU sensors are used. They are mated-pair by Bosch. Presumably LSU sensors work the best with CJ125 chips.

Together, LSU 4.9 and CJ125 make our ALM a more accurate lambda meter in the automotive aftermarket.

Besides air/fuel ratio measurement, ALM-S provides some supplemental functions which make your measurement or tuning more convenient: linear analog output to your ECU; LED digital display; engine RPM probe, data logging with a serial communication to a PC, etc.

## Chapter 2 ALM-S technical specifications

### Power supply

- ◆ Input voltage range DC 9V~15 V (12V Typical)
- ◆ Input current 90mA typical plus the heater current
- ◆ Polarity protection Reverse polarity protected
- ◆ Load Dump Clamp Maximum Voltage 33V

### Sensors

- ◆ Compatible LSU4.9 (LSU 4.2 capable but not recommended)
- ◆ Number of Sensors One
- ◆ Free air calibration Not required

### Measurement

- ◆ Lambda range  $\lambda = 0.65 \sim \infty$  (AFR: 9.56 to free air)
- ◆ Lambda accuracy  $\pm 0.008 @ \lambda = 1.00$   
 $\pm 0.01 @ \lambda = 0.80$   
 $\pm 0.05 @ \lambda = 1.70$
- ◆ Air/Fuel Ratio Fuel dependent (see lambda range and accuracy)

### Heater

- ◆ Control built-in PID control with CJ125
- ◆ Current Typical 600mA; Max 1.3A
- ◆ Heater return (H-) Separate wire from Ground

### Response time

- ◆ 5ms sampling rate

### Output

- ◆ Lambda analog output 0~5V user programmable
- ◆ Analog accuracy  $\pm 0.005V$  error with a 10-bit DAC chip
- ◆ Analog type Reference ground to ECU
- ◆ Narrow band O2 sensor simulated output

### Input

- ◆ RPM input Injection pick-up

### Communications

- ◆ advanced CAN bus communications (optional)
- ◆ RS232 or USB (via a converter)
- ◆ User-friendly PC software for data acquisitions and analysis

## Display

- ◆ 52mm digital guage with numbers in the censor and bar-graph LEDs around
- ◆ Low cost LED digital display (optional)

## Main-Processor

- ◆ CPU Freescale MC9S12P128 16-bit
- ◆ Speed 32MHz
- ◆ Memory 128k Flash, 6k Ram, 4k Data

## Special features

- ◆ On-Board-Diagnosis and error report
- ◆ Self-learning of part-to-part variations, aging effect
- ◆ Working with different types of fuels (gasoline, diesel, E85, etc)

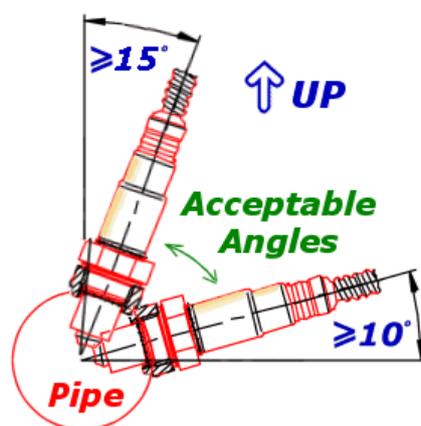
## General

- ◆ Temperature range -30°C ~ 125°C
- ◆ Dimensions 4" x 2.6" x 1"

## Chapter 3 Protect your oxygen sensor

### Installation

Correct installation of the oxygen sensors is a must to avoid sensor damage. It protects the oxygen sensor from condensations and gives the sensor longer life. It also can make the measurement more accurate. The sensor body should be perpendicular to the exhaust gas flow, and it should also be tilted in the range of  $10^{\circ}$ ~ $75^{\circ}$  from the horizontal line (see below figure). The typical tilt-angle is  $30^{\circ}$ . The sensor head should be close to the center of the exhaust pipe.



After finding the right location on the exhaust pipe, drill a hole of 18 mm in diameter. Weld the sensor bung on it.

**Note: do not weld the bung with the sensor in it.**

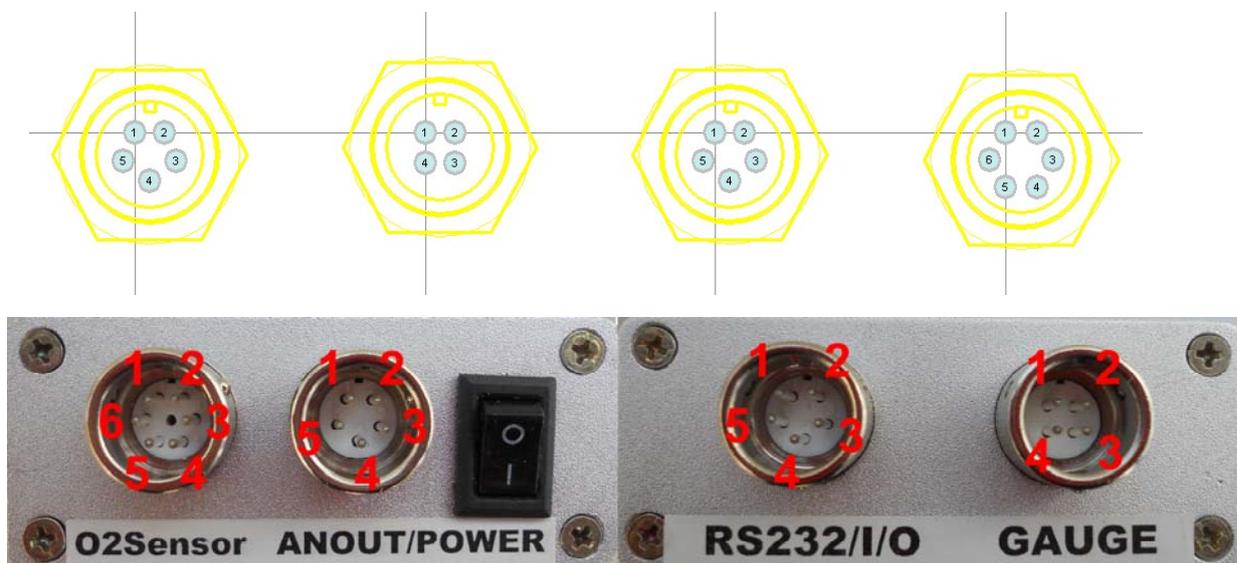
Note, if your vehicle has a Bosch switching oxygen sensor (LSF) on your vehicle, you can just un-plug the LSF, and plug-in the wideband LSU sensor into the hole. Bosch LSU and LSF have the same size of the thread.

### More User Notes

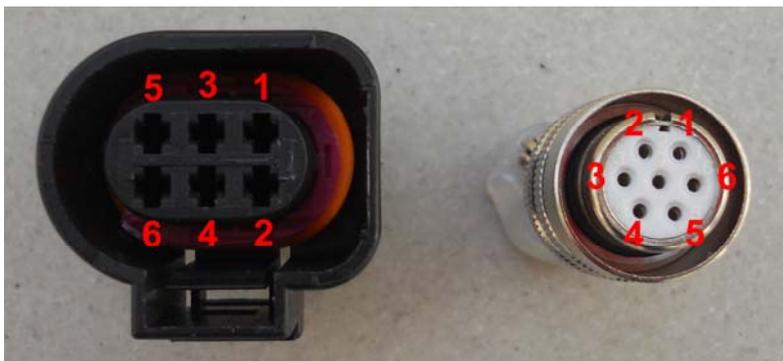
- ⚠️ LSU sensors are not designed to work with leaded gasoline. Using LSU sensor with leaded gasoline will reduce the sensor life.
- ⚠️ With the LSU sensor installed in the exhaust pipe, whenever the engine is running, please also run ALM-S, which controls the LSU heater. Otherwise, long-time-running engine with LSU sensor not heated can cause damage of the sensor.
- ⚠️ LSU sensor is preferred to run within the temperature range of  $500\sim 900^{\circ}\text{C}$ , the best temperature is  $750^{\circ}\text{C}$ . Too high temperature ( $>1030^{\circ}\text{C}$ ) will cause damage of the sensor. Refer to Bosch LSU4.9 data for more details about the variant temperature requirements.  
[www.bosch-motorsport.de/pdf/sensors/lambda/LSU49.pdf](http://www.bosch-motorsport.de/pdf/sensors/lambda/LSU49.pdf)
- ⚠️ Avoid heating the LSU sensor before the engine is running. At the engine start, there may be condensations in the exhaust gas, which can cause damage of the sensor. The preferred order: start the engine first, then immediately turn on the ALM-S, which will ramp up the heating power smoothly.

## Chapter 4 ALM-S hardware connections

### 4.1 ALM-S main connector pin-out

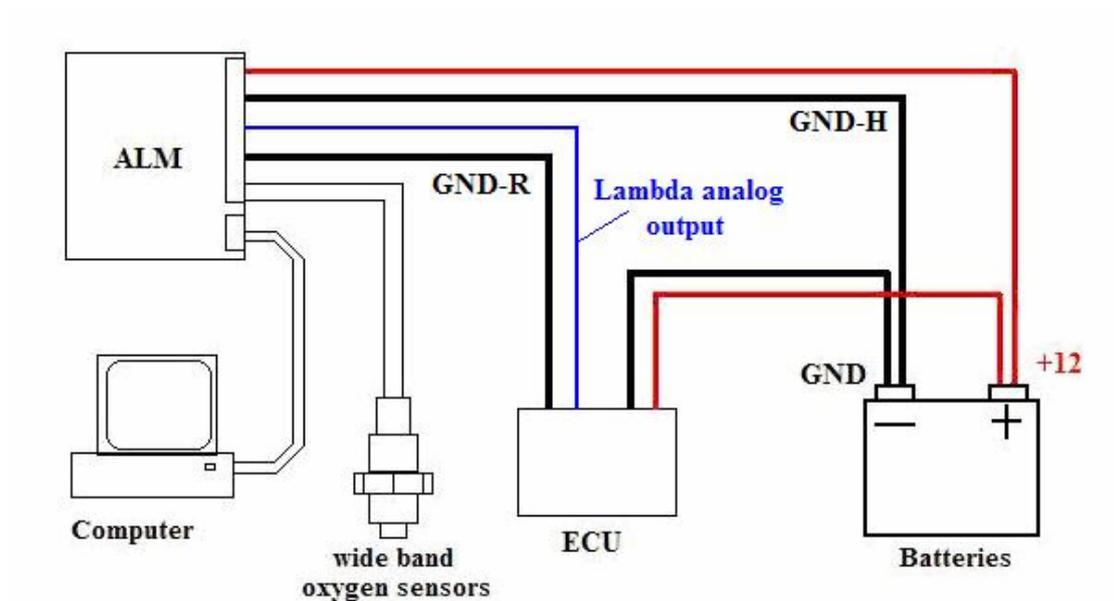


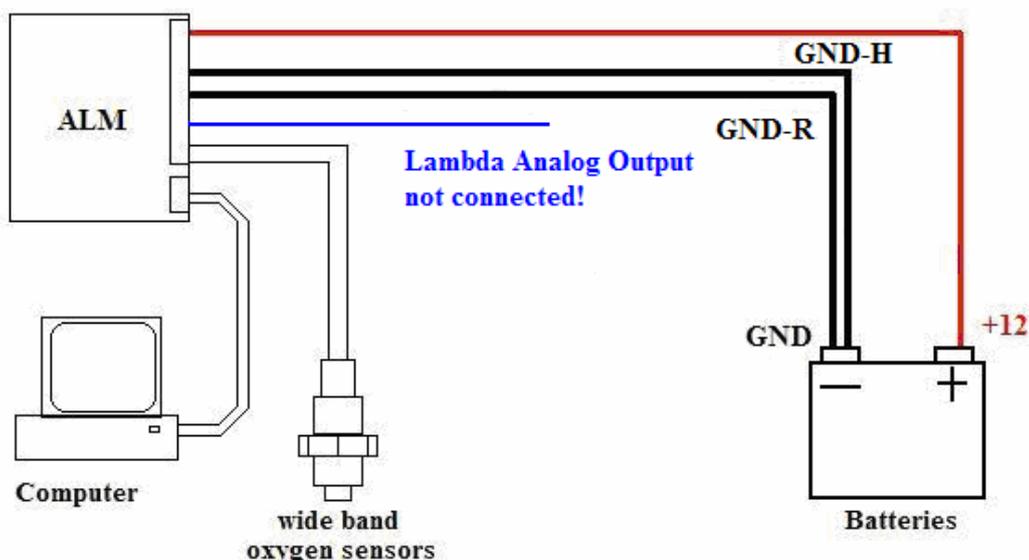
| Connector   | Pin# | Wire#  | Name   | Description                                  | Min  | Max |
|-------------|------|--------|--------|--|------|-----|
| Connector A | 1    | Gray   | TXD    |  |      |     |
|             | 2    | Purple | RPM    | injection signal input                       |      |     |
|             | 3    | yellow | RXD    |  |      |     |
|             | 4    | Green  | NO2OUT | Simulated narrow band oxygen sensor output   | 0.1V | 1V  |
|             | 5    | Black  | GND-R  | Ground (Reference ground)                    |      |     |
| Connector B | 1    | Yellow | +12V   | +12V Output                                  | 12V  | 12V |
|             | 2    | Red    | +12V   | +12V Output                                  | 12V  | 12V |
|             | 3    | Black  | GND-R  | Ground                                       |      |     |
|             | 4    | Green  | GAUGE  | coarse analog output to the gauge (optional) | 0V   | 1V  |
| Connector C | 1    | Black  | GND-R  | Ground (Reference ground)                    |      |     |
|             | 2    | Red    | +12V   | +12V Power supply                            | 9V   | 15V |
|             | 3    | Black  | GND-R  | Ground (Reference ground)                    |      |     |
|             | 4    | Blue   | ANOUT  | Lambda linear analog output (fine)           | 0V   | 5V  |
|             | 5    | Black  | GND-H  | Ground (Heater circuit ground)               |      |     |
| Connector D | 1    | 1/11   | IP     | Pump Current: to LSU4.9 pin 1 (Red)          |      |     |
|             | 2    | 2/12   | VM     | Virtual Ground: to LSU4.9 pin 2 (Yellow)     |      |     |
|             | 3    | 3/13   | H-     | Heater minus: to LSU4.9 pin 3 (White)        |      |     |
|             | 4    | 4/14   | H+     | Heater plus: to LSU4.9 pin4 (Grey)           |      |     |
|             | 5    | 5/15   | IA     | Trim Resistor: to LSU4.9 pin 5 (Green)       |      |     |
|             | 6    | 6/16   | UN     | Nernst Voltage: to LSU4.9 pin 6 (Black)      |      |     |



Note: LSU4.9 pin-out numbers are different than LSU4.2, but they have the same color scheme.

## 4.2 Connection overview





- 4.1 Plug-in the four connectors from the harness into ALM-S
- 4.2 Connect the 6-pin LSU4.9 mating connectors to the O2 sensor.
- 4.3 Connect the 12V+ to 12V battery plus or the DC power supply +;
- 4.4 Connect the GND-H (heater circuit ground) to 12V battery minus or the DC power supply ;
- 4.5 If you do NOT want to output the lambda analog signal to your ECU, connect the GND-R (**reference ground, pin4**) to the 12V battery minus or DC power supply ground; otherwise, refer to step 4.5 for GND connection.
- 4.6 **If you want to output the lambda analog signal to your ECU, connect the ALM-S lambda analog output to your ECU analog input, and then you must connect the ALM-S GND-R (reference ground, pin4) to the ECU analog GND** (most likely your ECU has a sensor ground for analog inputs).
- 4.7 Optional: Splice the injector-driver wire on the ECU side (usually low-side-driver type), and tap the ALM-S RPM input wire to it. Use the electrical tape to wrap it.
- 4.8 Optional: connect the switching O2 sensor simulated output to the OEM ECU. This can prevent the OEM ECU turn on the MIL light. Note, the OEM switching sensor can be different from each other, and it's your responsibility to figure out how to connect the wires correctly.
- 4.9 Optional: connect ALM-S to your laptop / PC via the serial communication cable (DB9 connector). If you computer does not have a serial port, you need an extra USB-RS232-converter.

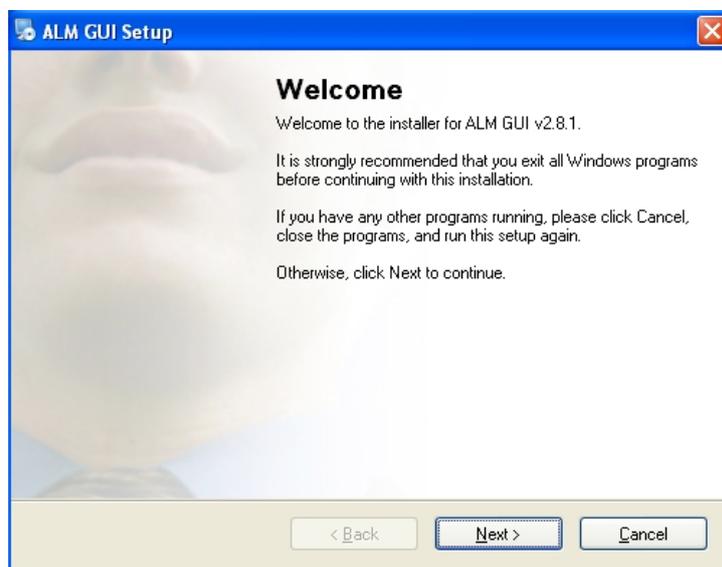
## Chapter 5 Software instructions

### 5.1 Install Software

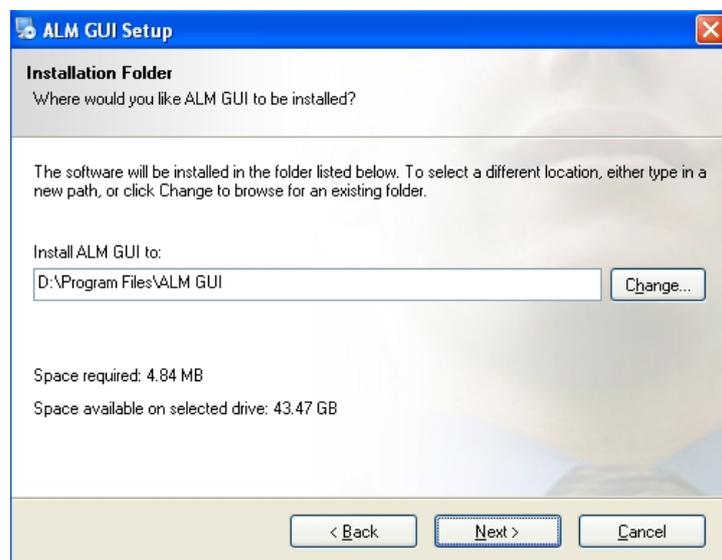
#### 5.1.1 Setup

Find the software installation folder on the CD, or you can download the latest software installation package from our website: <http://www.ecotrons.com/support.html>

#### 5.1.2 Welcome Window

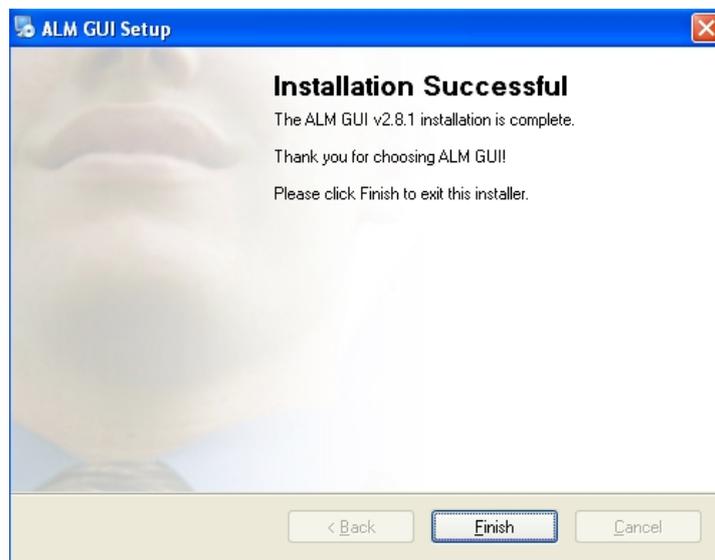


#### 5.1.3 Change Directory



You can change the destination directory if you don't want to install it into the default directory.  
Or click the installation button to continue.

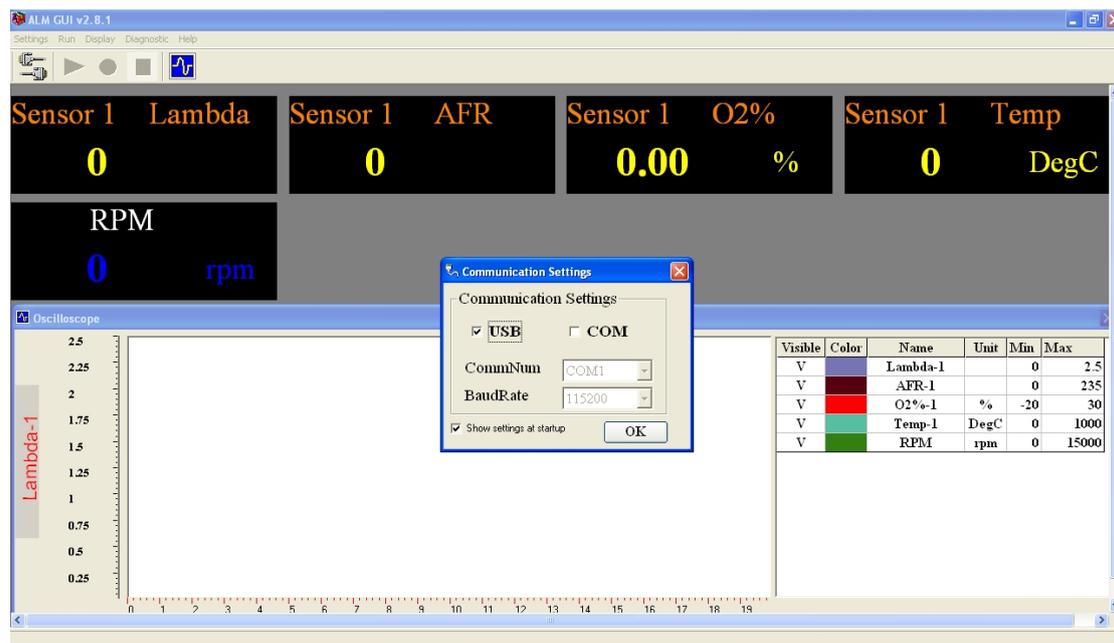
#### 5.1.4 Setup Successful



When you see "ALM-2 GUI Setup was completed successfully", it is done.

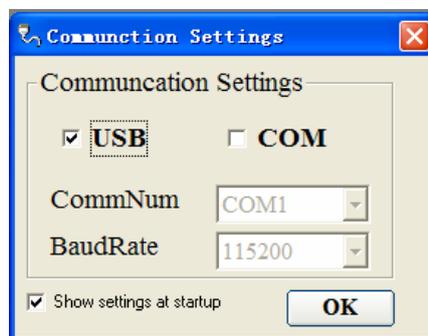
## 5.2 Using Software

To run the software GUI, go to Windows "Start -> Programs -> ALM-2 GUI -> ALM-2 GUI":  
A typical ALM-2 GUI running state will be like this:



Detailed descriptions of the GUI are as the following.

### 5.2.1 Communication Port Selection



The window at the start of the ALM-2 GUI will display, if you don't want to appear the window, please cancel the lower left corner of the check box.

User can choose USB (via an adaptor) or COM for logging or programming. We recommend using the USB, because most of the computer no COM.

### 5.2.2 Running the software

After the software GUI startup, these buttons will be displayed.



Click it, connect the ALM-S to PC



Click it to run the software



Click it to start recording data



Click it to stop recording data



Click it to start the data analysis software

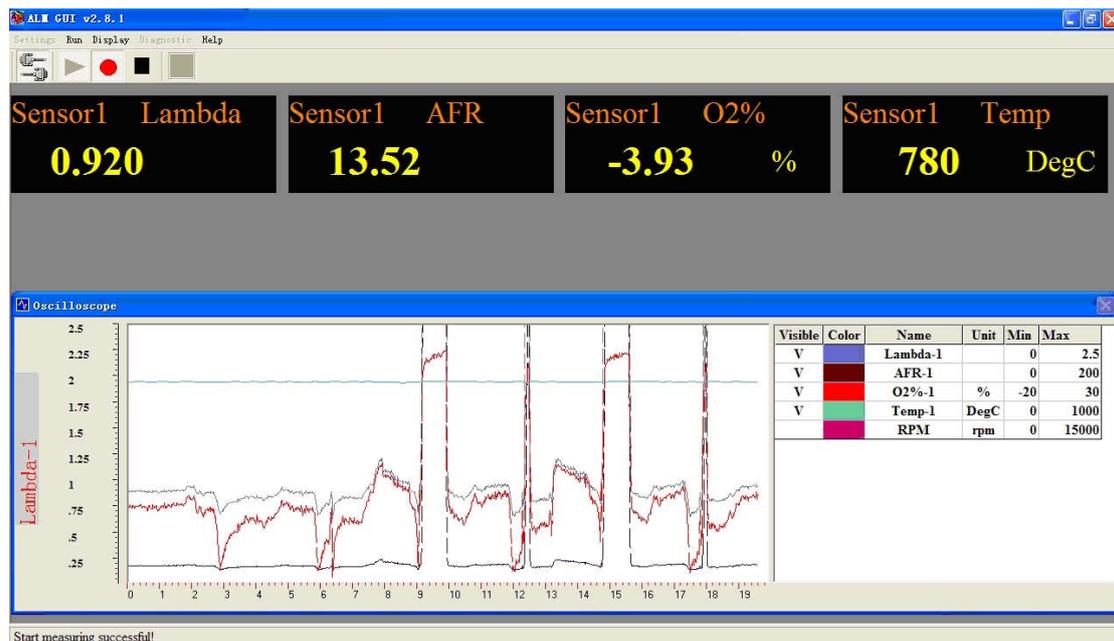
1. Before using the software online, make sure the communication lines between the ALM-S and the computer has been connected.

2. Click the  to connect the computer and ALM-S, The  turns green, indicating that online success.

3. Then click the , The screen displays the values began to change, then you can perform other operations.

### 5.2.3 Graph Window

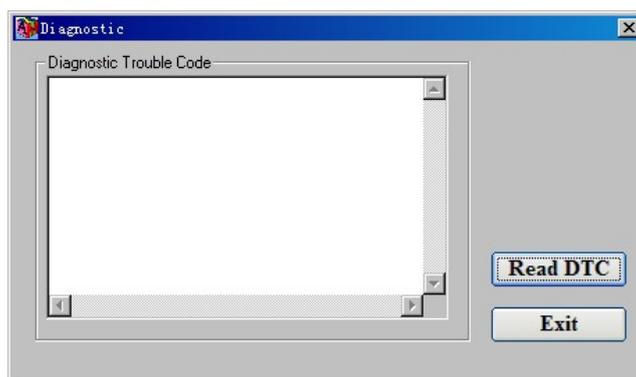
Once connected to the ALM-S, the Graph Window will draw the curves based on the real-time data. Left side is the axis info. Bottom side is the legends.



The signals that can be displayed in the graph window include:

- Lambda
- AFR
- Oxygen concentration (O2%)
- Temp (LSU sensor temperature)
- RPM (optional)

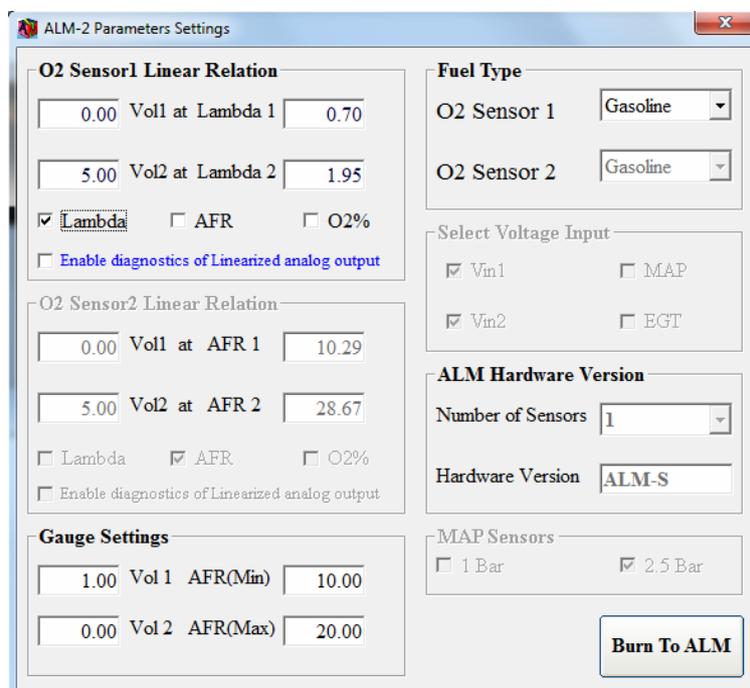
### 5.2.4 Diagnostic Trouble Code



Click "Read DTC" button, GUI will read the active DTCs from ALM-S memory, example as in the above window. Refer to DTC table [chapter 6] for all DTCs ALM-S supported.

### 5.2.5 ALM-S GUI Parameters Settings

Users can configure the ALM-S linear analog output. This analog output from ALM-S is linear to the actual Lambda/AFR/O2% measured. By setting the lower point and upper point of voltage vs. Lambda/AFR/O2% linear relation, the scaling between the voltage and Lambda/AFR/O2% is determined. Default is: Vol1=0, Vol2=5.



Lambda mode, the default setting:  
 0 Volt @ at Lambda 0.7  
 5 Volt @ at Lambda 1.95

Then  $\lambda = \text{Volt} * (1.95 - 0.7) / (5.0 - 0.7) + 0.7$ , which is:  $\lambda = \text{Volt} * 0.25 + 0.7$ ;

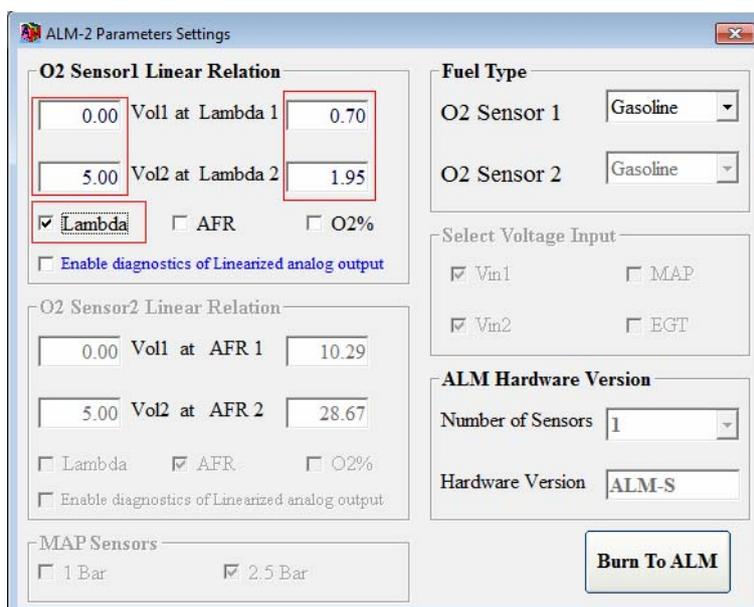
As an example, with this setting, at  $\lambda = 1$ , Volt = 1.20V.

After the settings, you need to click **"Burn To ALM"** button to activate it.

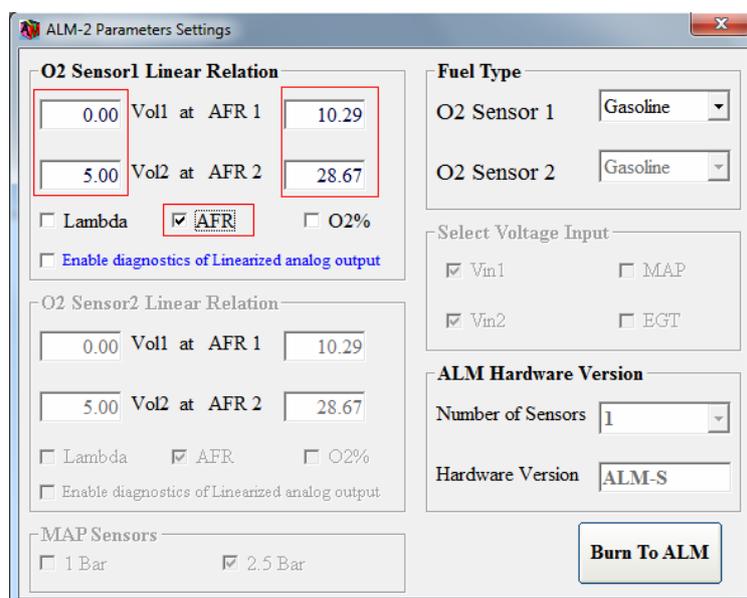
**Note:**

1. ALM-S uses a 10-bit DAC conversion chip to convert the measured lambda to an analog voltage. By default, the resolution of the DAC chip is 0.005V. This error is negligible, when you convert a lambda value to a 0-5v analog signal, because the sensor accuracy error is much bigger than this error. When outputting lambda analog signal to the ECU, ALM-S does not use PWM to analog converting circuit, which can add large errors on top of sensor accuracy error.

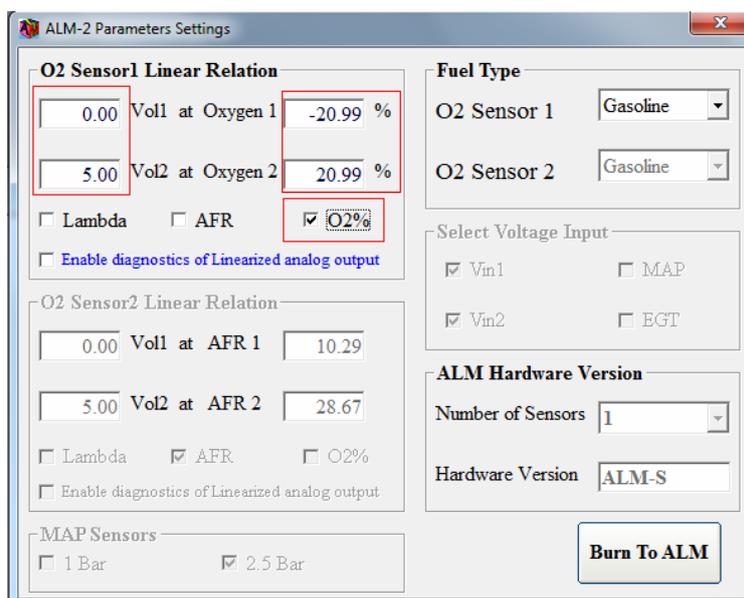
Three different settings see the following figure:



Analog output is used to indicate lambda



Analog output is used to indicate AFR



Analog output is used to indicate O2%

User can select the fuel type, by select fuel type, the conversion between lambda and the AFR will change correspondingly.

- Gasoline
- LPG (Propane)
- Methanol
- Ethanol
- CNG
- Diesel

### 5.2.6 Analog output diagnosis capability

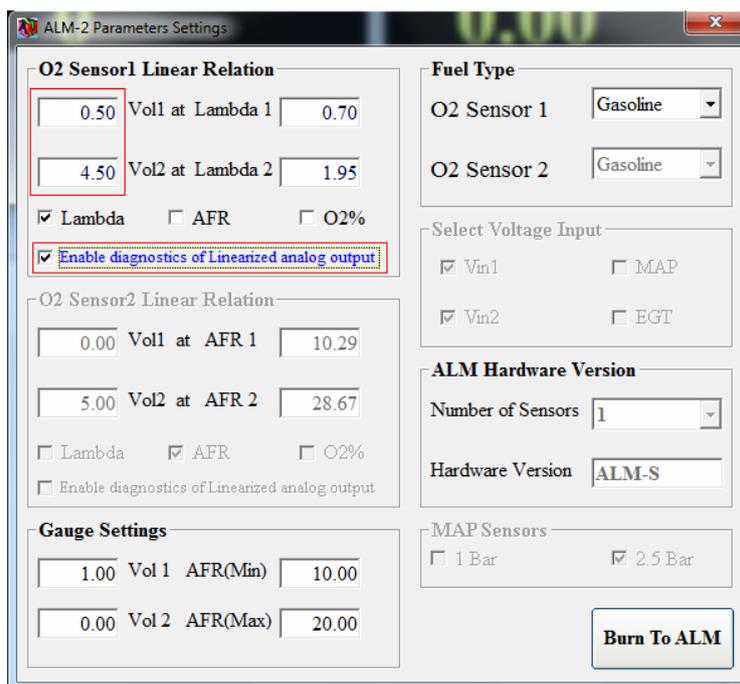
Analog output of ALM to have a fault diagnostic capability. By default, is disabled. You can choose **Enable diagnostics of Linearized analog output** to enable it.

After the diagnosis capability is enable, linear output voltage range must be changed to 0.5v to 4.5v. This means:

- 1) The analog output will be in the range of 0.5v to 4.5v when the O2 sensor is normal working.
- 2) It will be <0.5v for a group of errors. (Approximately equal to 0v)
- 3) It will be > 4.5v for another group for errors. (Approximately equal to 5v)
- 4) Fault code E1, E2, E4, E6, E8, E9, E12, analog output is 0v, other fault code output 5v.

When the error occurred, the specific fault code can query diagnostic functions. (See 5.2.4 Diagnostic Trouble Code)

Fault codes means, see Chapter 6 DTC table.



### 5.2.7 Real-Time Signals

Real-time display of the data sent from ALM-S.

AFR: Air/fuel ratio

Lambda:  $\lambda$  ( $\lambda = \text{AFR}/14.7$  for gasoline)

RPM: Engine speed

Vin1: Analog channels 1

Vin2: Analog channels 2

Temp: LSU Sensor temperature

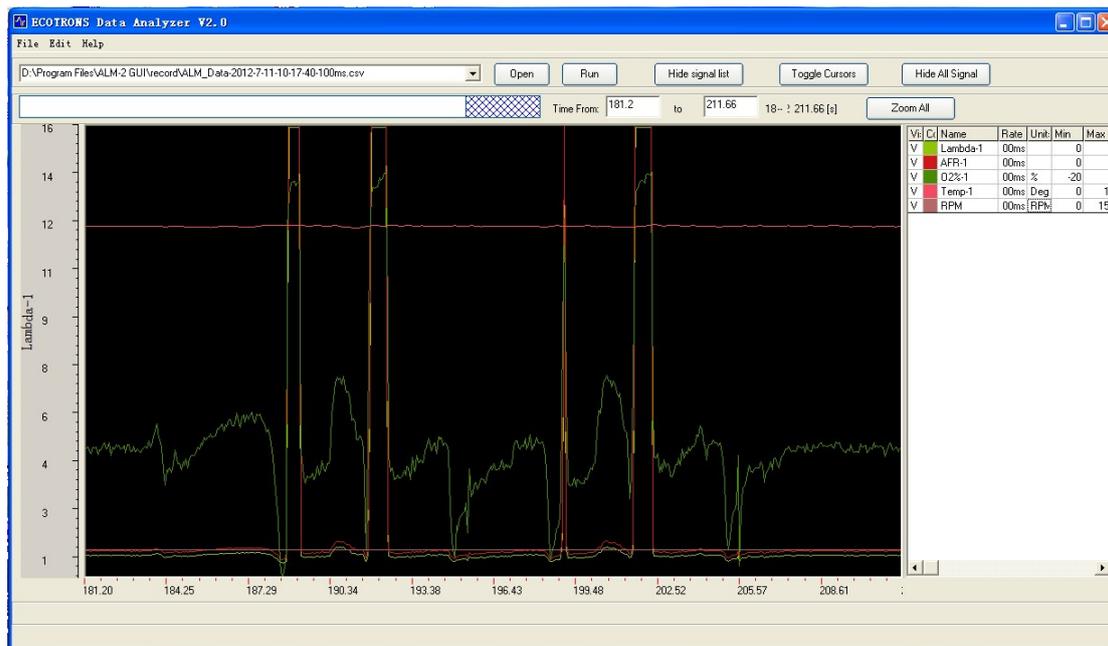
### 5.2.8 Data logging and play-back

All real-time data sent from ALM-S to PC GUI can be logged in the CSV file format, which can be played back with our ALM-S Data Analyzer.

Procedures to log and view data are as follows:



ALM-S Data Analyzer can also run stand-alone. Users can load the previously logged file into it and do the data analysis in the graphical view.



Steps:

1. Click File->Open; select the CSV data files, Click "Open" Load files.

2. 

| Min | Max |
|-----|-----|
| 0   | 100 |

For every signal, users can manually adjust the "Min/Max" value, and the Y-axis of the signals in the Graph Window will change correspondingly. This can be used to as "zoom in" function for the Y-axis.

3. 

|             |                                 |           |                                    |     |
|-------------|---------------------------------|-----------|------------------------------------|-----|
| Start Time: | <input type="text" value="50"/> | End Time: | <input type="text" value="174.9"/> | [s] |
|-------------|---------------------------------|-----------|------------------------------------|-----|

User can also manually type in the "start time" and "end time" for the X-axis. This can be used as "zoom in/out" of the X-axis.

4. Click  , users can turn on/off the curser in the Graph Window. All signal values at the cursor place will show up at the right signal column.



## Chapter 6 DTC table

Below is the Diagnostic Trouble Code table. ALM-S has on-board-diagnostics capability to detect most common errors. The first thing user should do when ALM-S is not working appropriately is to read DTCs.

| Trouble Code | Description                         | Solutions  |
|--------------|-------------------------------------|--|
| E1           | Internal communication error        | Contact the manufacturer   |
| E2           | Internal register error             | Contact the manufacturer   |
| E3           | LSU yellow wire (VM) short to power | 1. Check the harness for short-to-power<br>2. Change the LSU                             |
| E4           | LSU yellow wire (VM) short to GND   | 1. Check the harness for short-to-ground<br>2. Change the LSU                            |
| E5           | LSU black wire (UN) short to power  | 1. Check the harness for short-to-power<br>2. Change the LSU                             |
| E6           | LSU black wire (UN) short to GND    | 1. Check the harness for short-to-ground<br>2. Change the LSU                            |
| E7           | LSU green wire (IA) short to power  | 1. Check the harness for short-to-power<br>2. Change the LSU                             |
| E8           | LSU green wire (IA) short to GND    | 1. Check the harness for short-to-ground<br>2. Change the LSU                            |
| E9           | Operating voltage too low           | Check the power supply to the ALM-S spec.  |
| E10          | Heater circuit damaged              | Contact the manufacturer   |
| E11          | Heater circuit short to power       | Contact the manufacturer   |
| E12          | Heater circuit short to GND         | 1. Check the harness for short-to-ground<br>2. change LSU<br>3. Contact the manufacturer |

## Chapter 7 Frequently Asked Questions

### 7.1 ALM-GUIANOUT set

Vol1 and Vol2 are used to control the analog output voltage range, default is: Vol1=0, Vol2=5. It can be respectively corresponding to the lambda, AFR and Oxygen concentration. There are three different ways, See Figure 1, 2, 3.

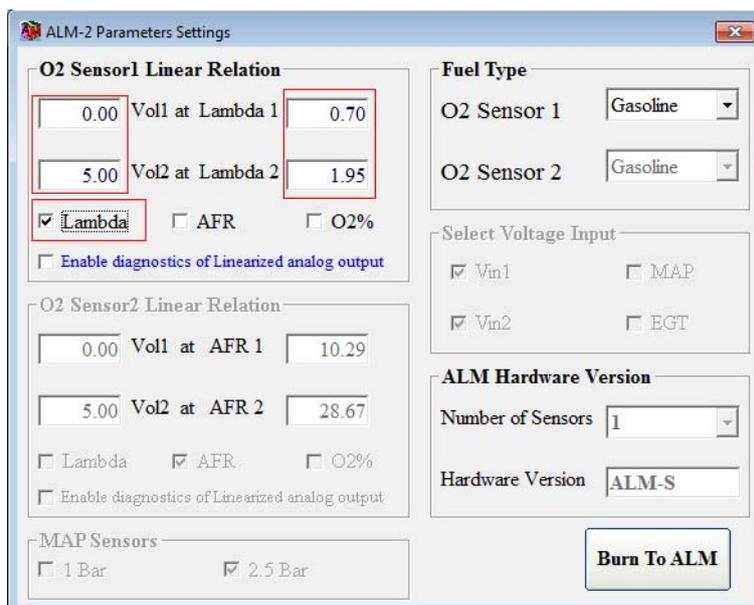


Figure 1 Analog output is used to indicate lambda

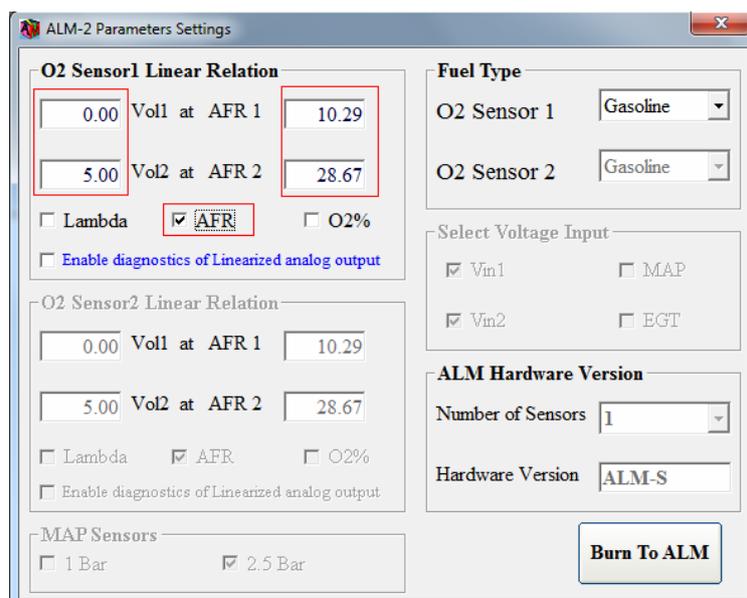


Figure 2 Analog output is used to indicate AFR

If you want to indicate changes in oxygen concentration, the password input box will pop

up when you click on the O2%, Please enter the password: **idjfd845**, and then click "OK".

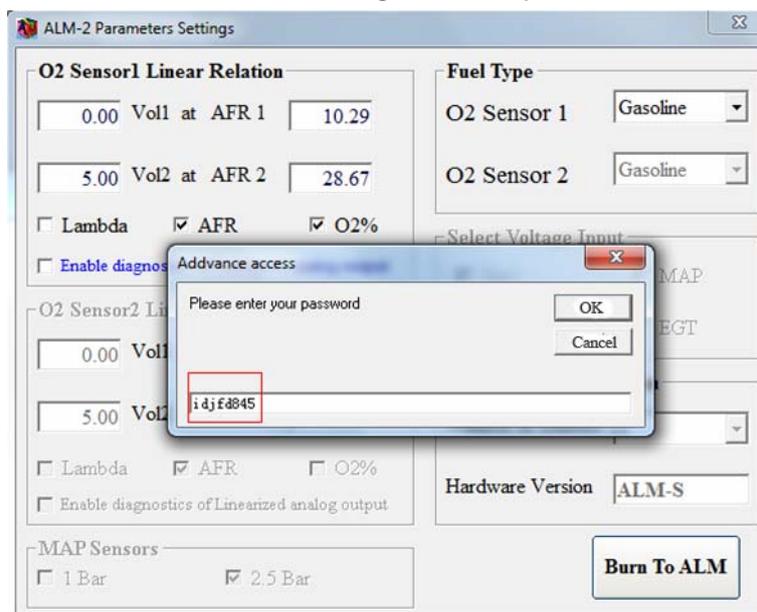


Figure 3 enter the password

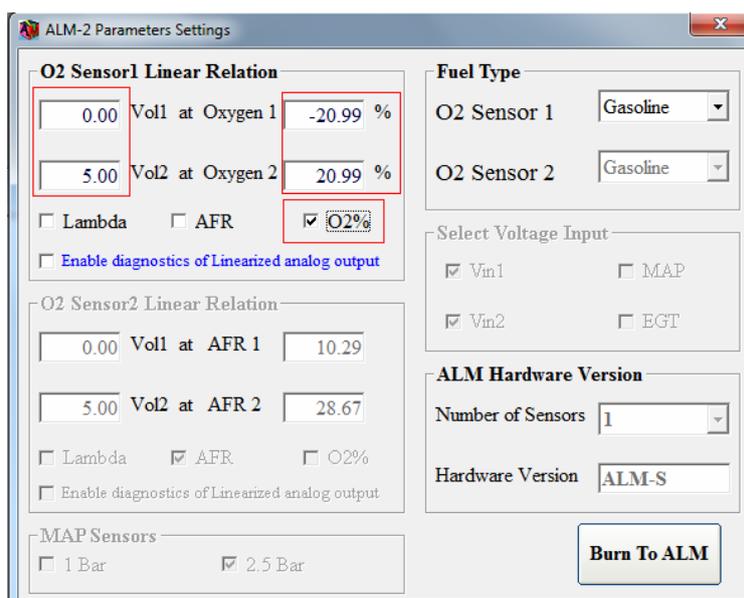


Figure 4 Analog output is used to indicate O2%

After the setup is complete, you must press the "burn to ALM" button.  
Your settings programmed into the ALM.

## 7.2 Program ALM with Flash GUI

Rename the installation file name that is attached in the Email: **"Flash GUI v2.7.5-setup.exe.remove"**

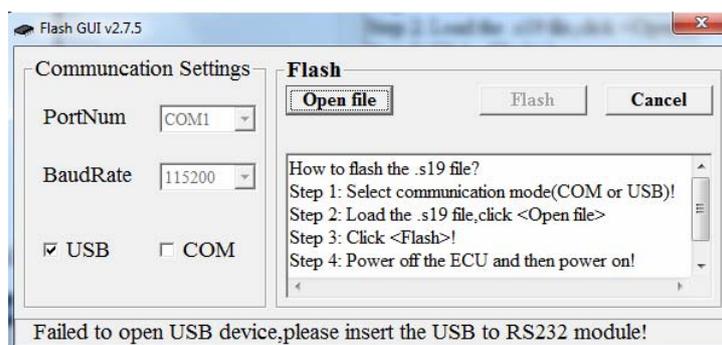
Please modify the attached file name extension, and remove the ".remove", then run the file: "Flash GUI v2.7.5-setup.exe" to install the tool software, and follow the instructions to program

the ECU.

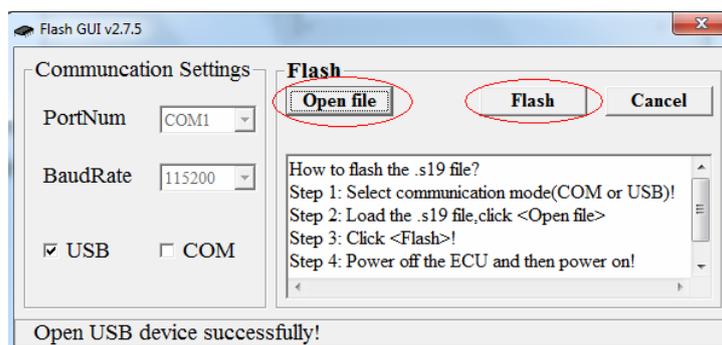
Install and open the "Flash GUI.exe" first.

Start program ECU with Flash GUI:

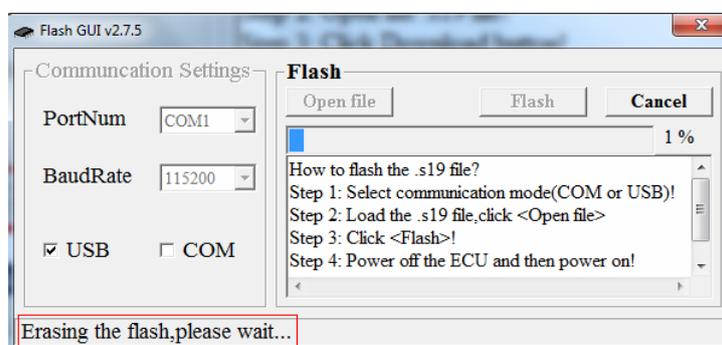
- (1) Connect your laptop with a USB or RS232 to ALM harness.
- (2) Open "Flash GUI 2.7.5"; select USB or COM.

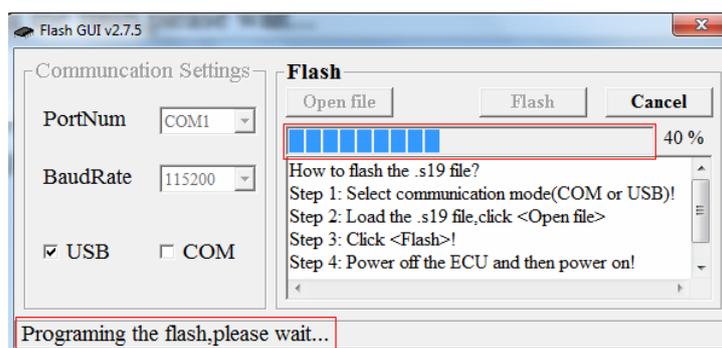


- (3) Click "Open file" button to open the S19 file, then click "Flash" button

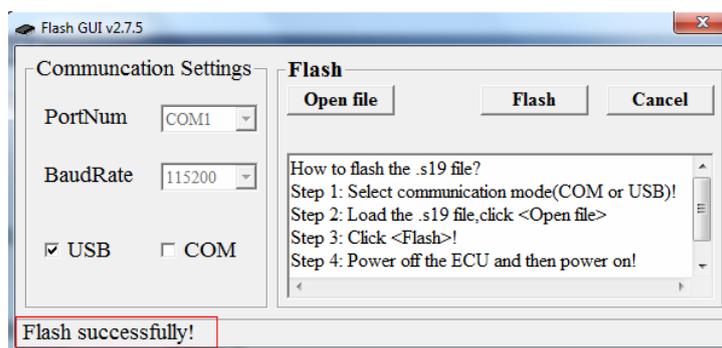


- (4) Key on the bike to power on the ALM. You should see the "Flash GUI 2.7.5" start to work and the blue progressing bar running. Wait it to finish.

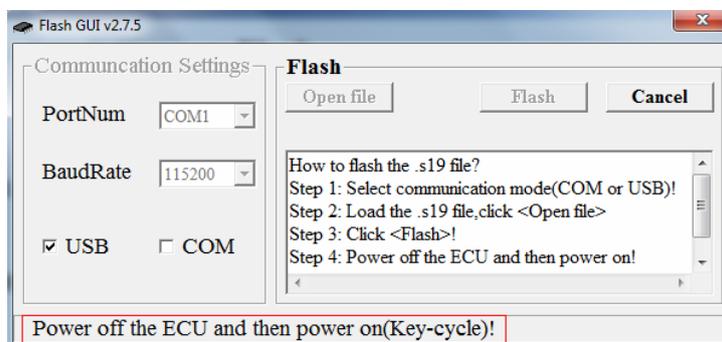




When it Flash successfully, it will prompt information "Flash successfully!" and you will hear the fuel pump running for a couple seconds.

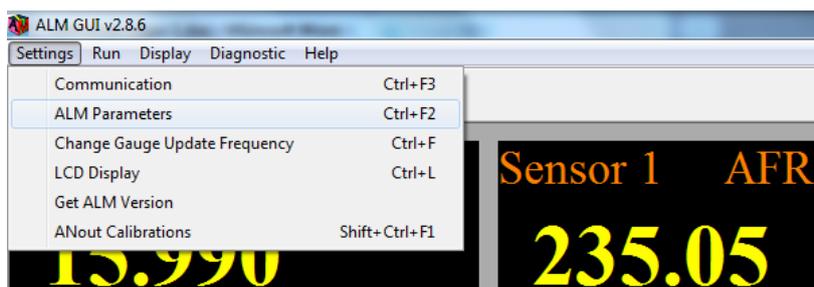


**If the ALM has been powered on, please Key off then key on again. And do the same above operation.**



### 7.3 Calibration set

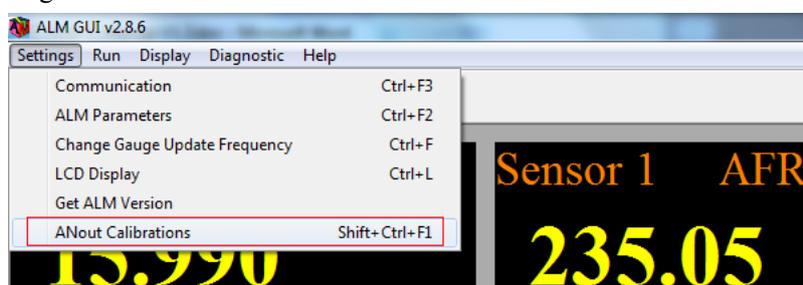
- (1) Connecting ALM and PC (via serial or USB)
- (2) Download the S19 file (See 7.2 section: Program ALM with Flash GUI)
- (3) Open ALM GUI; Click the Connect button after the connection is successful, click Settings->ALM Parameters



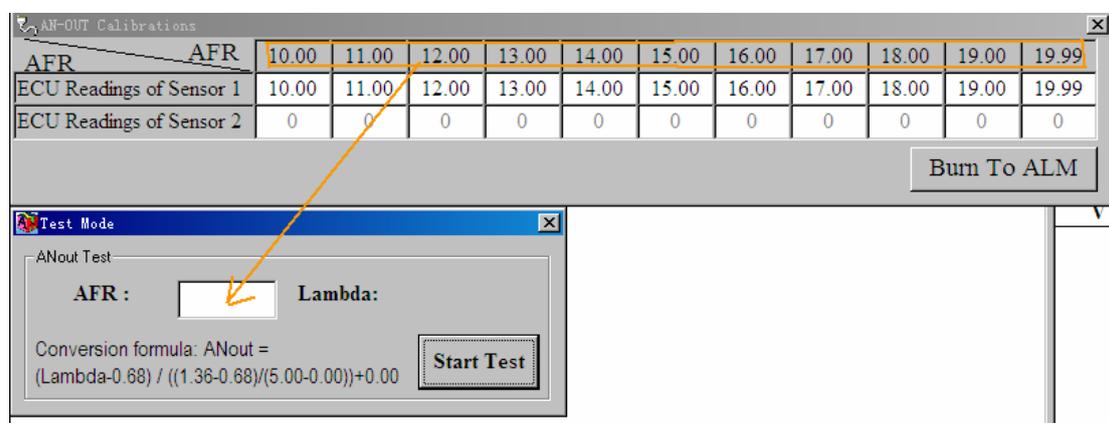
(4) Set the analog output (See 7.1 section: ALM-GUI ANOUT set)

### 7.4 How to calibration ECU readings of ALM analog output

1. Power on the ALM, and launch the ALM GUI (You must install the latest version), connect it to ALM.
2. Go to Settings→Anout Calibrations.



It will show two windows, one is the calibration window, and the other is test mode window.



The first row of AN-OUT calibrations window is the reference AFR, it comes from O2 sensor 1 linear relation. For example, your settings is 0 v→10 AFR, 5 v→20 AFR Then divide the AFR into 10 parts, regular growth, so it is "10-11-12-13-14-15-16-17-18-19-20".

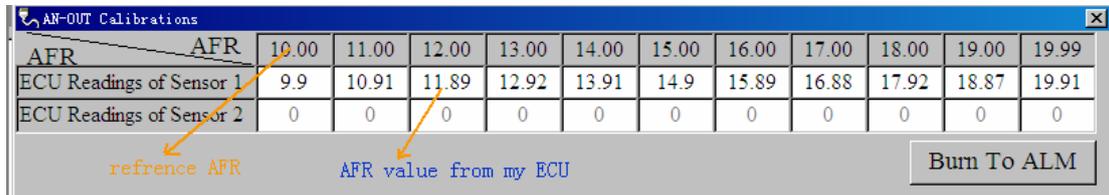
The second row is the ECU readings, you need to get the value from ECU (or the software on PC), then fill in the corresponding cell of second row.

3. Start the calibration.

For example, fill the value "10.00" into the text box of test mode window, then click button "Start Test". The ALM wills in the test mode, the output AFR is the value you entered (Reset the ALM or click "Start Measuring" of ALM GUI will leave the test mode).

Your ECU will read AFR of 10, or less than 10(9.9). Fill the AFR value you get from ECU into the cell of AN-OUT calibration window (second row).

Start to test AFR of "11", then "12", until 20.



| AFR                      | AFR | 10.00 | 11.00 | 12.00 | 13.00 | 14.00 | 15.00 | 16.00 | 17.00 | 18.00 | 19.00 | 19.99 |
|--------------------------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| ECU Readings of Sensor 1 |     | 9.9   | 10.91 | 11.89 | 12.92 | 13.91 | 14.9  | 15.89 | 16.88 | 17.92 | 18.87 | 19.91 |
| ECU Readings of Sensor 2 |     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |

reference AFR      AFR value from my ECU

Burn To ALM

Click button <Burn To ECU> after test all the reference value. If setup is successful, it will show "Set successfully" at the lower left corner. The ALM will calibrate by itself.

**Set successfully !**

## Chapter 8 Appendix: LSU4.9 vs LSU4.2

| Characteristics                       | LSU4.2                                   | LSU4.9                                      | Notes   |
|---------------------------------------|--|---|---|
| lambda range                          | lambda = 0.65 ~ ∞                        | lambda = 0.65 ~ ∞                           |   |
| Accuracy                              | only good at lambda = 1 or moderate rich | accurate at both rich and lean, wider range | LSU4.2 is only accuracy at lambda =1 and moderate rich, between 0.8~1.0 lambda; LSU4.9 has better accuracy in both rich and lean conditions, suitable for gasoline, diesel, CNG, etc.   |
| Response time                         | Slower                                   | Faster                                      | Thinner sensing element of LSU4.9 makes it more responsive to the AFR change, dynamically more accurate, and easier to light off, less heating power needed.  |
| Heating power                         | 10W                                      | 7.5W  | LSU4.2 has the off-centered-heater vs. LSU 4.9 has the centered-heater in the laminate; LSU4.9 has better heating efficiency, less heating power needed.  |
| Free air calibrations                 | needed                                   | not needed                                  | LSU4.2 is susceptible to reference air contaminations, which is called CSD (characteristic shift down), requires frequent free-air calibration. LSU4.9 uses reference pump current instead of reference air. No more CSD. No requirement of free-air calibrations |
| Nerst cell resistance vs. temperature | 80 Ω → 750 C                             | 300 Ω → 790 C                               | LSU4.9 has higher resolution of internal resistance vs. temperature characteristics, which makes the temperature measurement more accurate, and better heater control, therefore higher accuracy of lambda.   |
| Light off time                        | long                                     | short                                       | LSU4.9 lights off faster. Lambda controls can be active much faster during warm up phase.   |
| Reliability                           |  | Improved reliability                        | LSU4.9 is superior than LSU4.2 with regard to reliability and life.   |
| Check with Bosch                      | Still selling it                         | Recommended                                 | Bosch recommends LSU4.9 to all OEMs.<br>Bosch uses LSU4.9 for it's own wideband controller<br><a href="http://www.bosch-motorsport.de/pdf/communication/signal_processing/LT4.pdf">http://www.bosch-motorsport.de/pdf/communication/signal_processing/LT4.pdf</a> |