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AiM Infotech

LCU–ONE Analog User manual

Release 1.02







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Chapter 1 – LCU-ONE Description

LCU-ONE is a lambda controller unit for wide band BOSCH LSU 4.9 lambda probe; it fits petrol (2 and 4 strokes), diesel and methane engines as well as alcohol based fuel engines. It is intended to check lambda probe proper working as well as to transmit the Air/fuel ratio values providing **MXL/EVO3** with lambda values through the CAN bus.

Lambda value is defined as: LAMBDA= (A/F)/(A Stoichiometric /F Stoichiometric).

where:

A = incoming parts of air;

F = parts of petrol the carburetor injects into the engine;

A Stoichiometric / F Stoichiometric = parts of air needed to burn Stoichiometric F;

Speaking about gasoline, for example, it needs 14,57 parts of air to completely burn a part of gasoline, obtaining Lambda value = 1 read by the probe.

LCU-ONE controller can detect lambda values in a range of 0.65 to 1.6 (free air).

It is reminded that LAMBDA value lower than 1 means a rich mixture, while LAMBDA value higher than 1 means a lean mixture.

Wide band Lambda probes need to be heated to work properly and not poisoned with exhaust gas; **LCU-ONE** controller precisely manages the probe heater so to keep temperature value in the optimum working range.

Lambda probe used with LCU-ONE controller becomes very hot (around 700-800 °C, 1292-1472 °F) during its working period, it is thereby necessary AVOIDING:

- touching it.
- placing it in contact with flammable stuff or fuel.

Please note:

disrespect of these warnings can cause shocks, burnings or explosions.



Chapter 2 – LCU-ONE and Lambda probe mounting

LCU-ONE controller should be installed in a flat location and far from heat sources; it should be mounted steady using the suited bracket.

The wiring has to be arranged so to avoid it passing near to heat sources.

LCU-ONE is to be powered by the engine master switch.

BOSCH LSU 4.9 Lambda probe should be installed on the vehicle exhaust pipe using a specific adaptor that comes with the kit and should be welded on the same pipe. The probe should be sufficiently near to the engine.

Probe working temperature should not exceed 900°C (1652°F) and it should not be exposed to the free flame coming from the exhaust system.

Probe installation angle should be of at least 10° to avoid liquid condensation stuff to come in contact with the probe, polluting it.



Once the probe is installed, pay attention not to let the cable pass near to excessive heat sources (the exhaust pipe for example).

Bosch LSU 4.9 probe auto-calibrates: no calibration is then required by the user.

Solvents or additives should not be used to clean the probe connector. To protect the probe we would suggest to remove it from the vehicle when cleaning the vehicle to avoid polluting the probe with detergents.

It is reminded to never switch the vehicle on with Lambda probe installed and not connected to a correctly working **LCU-ONE** controller: a probe not heated and exposed to exhaust gas would be irremediably damaged.

N.B. BOSCH LSU 4.9 Lambda probe has been designed to be used with unleaded or diesel engine: it can be used with other kind of engines too but its duration needs to be tested by the user.



Chapter 3 – Configuration

To work properly **LCU-ONE Analog** needs to be configured. The configuration can be made both using **Race Studio 2** and using **Lambda Configurator** the free software - included in the kit - properly designed and developed by AIM to configure this device.

3.1 – LCU-ONE Analog standard configuration

Configuration through **Race Studio 2** (standard) is possible only if calibration curve default points -1.95 ± 0.65 and 4.8 ± 1.6 – have not been modified.

To configure LCU-ONE Analog with Race Studio Configuration follow this procedure:

- run the software;
- press "AIM system manager" button on the left vertical keyboard;
- select the logger LCU-ONE Analog is connected to
- activate "Channels" layer
- select the analogue channel to set the probe on
- double click on "Sensor type" column corresponding to that channel and select "AIM Lambda LCU-ONE 1.65 – 1.6 Lambda)" option as shown here below; click out of the cell to confirm the choice.

| 🛛 System manager | | | | | | | | | | |
|--|-----------------------------|-----------------|--------------|-----------------|--|-----------------------------|------|---------------|-----------------|-----------------|
| Transmit Receive CAN-Net info | | | | | | | | | | |
| Current configuration | | | | | | | | | | |
| Installation name | Data logger type | Ecu | Vehicle name | Available time | Time with GPS | Total frequency | Mas | ter frequency | Expansions freq | Tot. Expansions |
| DEFAULT | MXL PISTA | SUZUKI - GSXR | DEFAULT | 12.41.26 (h.m.: | s) 4.36.03 (h.m.s) | 91 (Hz) | 91 (| Hz) | 0 (Hz) | 1 |
| | | | | | | | | | | |
| Select configuration Channels System configuration CAN-Expansions configurator | | | | | | | | | | |
| -Speed 1 | | | | | | | | | | |
| spood_1 | | _ | | | | | | | | |
| Wheel circumfer | rence (mm) 736 | | | | | | | | | |
| Pulses ner whee | el revolution 4 | - | | | | | | | | |
| | J | | | | | | | | | |
| Channel iden | Enabled/disabled | Channel name | | Sampling frequ | Sensor type | | | Measure unit | Low scale | High scale |
| RPM | Enabled | Engine | | 10 Hz • | Engine revolution spee | d | | rpm | 0 | 16000 |
| SPD_1 | Enabled | Speed_1 | | 10 Hz 🗾 | Speed | | - | km/h .1 | 0.0 | 300.0 |
| CH_1 | Enabled | Oil_Press | | 10 Hz 🗾 | Generic linear 0-5 V | | - | V .1 | • 0.0 | 5.0 |
| CH_2 | Enabled | Fuel_Level | | 10 Hz 💌 | Fuel level | | - | % | 0 | 100 |
| CH_3 | Disabled | Channel_3 | | 10 Hz 💌 | Generic linear 0-5 V | | - | V .1 | • 0.0 | 5.0 |
| CH_4 | Disabled | Channel_4 | | 10 Hz 💌 | Lambda sensor NGK TL | .7111W1 - NTK TC6110 | - | A/F .1 | • 0.0 | 5.0 |
| CH_5 | Disabled | Channel_5 | | 10 Hz 💌 | Pressure VDO 0-2 bar | | ~ | V.1 | • 0.0 | 5.0 |
| CH_6 | Disabled | Channel_6 | | 10 Hz 👱 | Pressure VDO 0-5 bar | | | V .1 | • 0.0 | 5.0 |
| CH_7 | Disabled | Channel_7 | | 10 Hz 👱 | AIRBOX pressure sense | , or - X055NAB01 | | V.1 | • 0.0 | 5.0 |
| CH_8 | Disabled | Channel_8 | | 10 Hz 👱 | AIRBOX pressure sense | or - X05SNAB00 | | V .1 | • 0.0 | 5.0 |
| CALC_GEAR | Disabled | Calculated_Gear | | 10 Hz 👱 | Zero based potentiometer | r eter | | # | 0 | 9 |
| ACC_1 | Enabled | LatAcc | | 10 Hz 🗾 | Mid zero potentiometer | r | | g .01 | -3.00 | 3.00 |
| LOG_TMP | 🕅 Enabled | Datalogger_Temp | | 10 Hz 👱 | Lambda sensor BOSCH | 7111W1 - NTK TC6110 | | ℃ . | • 0 | 50 |
| BATT | 🕅 Enabled | Battery | | 1 Hz 👱 | Water pitot speed sens | sor | | V .1 | 5.0 | 15.0 |
| ECU_1 | Enabled | ECT | | 10 Hz 👱 | External vertical accele | erometer | | ℃ . | - 0 | 130 |
| ECU_2 | 🕅 Enabled | GEAR | | 10 Hz 👱 | External horiz. accelere | ometer | | # | 0 | 7 |
| ECU_9 | Enabled | MODESEL | | 10 Hz 👱 | Generic linear 0-5 V | v | | # | 0 | 3 |
| | | | | | Generic linear 0-50 mV | | | | | |
| | | | | | MSI 0-100 psi sensor MSI 0-150 psi sensor | | | | | |
| | | | | | SEAT Brake Pressure | | | | | |
| | | | | | SEAT Engine Pressure SEAT Water Temperatu | ure | | | | |
| | | | | | Water Temp Suzuki GS | XR | | | | |
| | | | | | Status signal | | | | | |
| | | | | | Temp Weber ATS 04 (1 | 1200 Ohm) | | | | |
| | | | | | AIM Lambda LCU-ONE | 410 (0,65 - 1,6 lambda) | | | | |
| | | | | | MSI 0-2000 PSI sensor | | | | | |
| | | | | | Sub_H2O | | | | | |
| | | | | | Custom_001 | | - | | | |
| | | | | | [custom_002 | | | | | |
| | | | | | | | | | | |



• Set the probe configuration panel that appears bottom left of channel layer, highlighted in the image below.

| | iansai | D | | CAN-Net | into 🔗 | Set acquisition (| ystem | | | |
|---|------------------|--------------------------|---------------------|-----------------|------------------------|---|------------------------------|-----------|-----------------|---|
| | | | aparana 🎽 | Carna | | time | | | | |
| ient configurati | ion | | | | | | Contract of Contract of Con- | gina a su | | alla de la companya de la companya La companya de la comp |
| stallation name | Data logger type | e Ecu | Vehicle name | Available time | Time with GPS | Total frequency | Master free | illency | Expansions freq | Tot. Expansion |
| FAULT | MKL PISTA | SUZUKI - OSXR | DEFAULT | 12.41.26 (h.m.) | i) 4.36.03 (h.m.s) | 91 (Hz) | 91 (Hz) | | 0 (Hz) | 0 |
| lect configural peed_1 /heel circumfe | rence (mm) 73 | stem configuration CAM | Expansions configue | ator | | | | | | |
| hannel iden | Enabled/disabled | Chargel parte | | Sampling frequ | Cancer hone | | Measure uni | t I.ou | scale Hi | th scale |
| PM | F Enabled | Engine | | 10 Hz * | Engine revolution spec | rd . | rpm | 0 | 16 | 000 |
| 0.1 | Enabled | Speed 1 | | 10 Hz . | Speed | | * km/h .1 | 0.0 | 30 | 0.0 |
| u | Enabled | OI_Press | | 10 Hz - | AIM Lambda LCU-ONE | (0,65 - 1,6 la | - A/F .1 | . 0.0 | 5.0 |) |
| 2 | Enabled | Fuel_Level | | 10 Hz . | Fuel level | | • % | 0 | 10 | 0 |
| 3 | Cisabled | Channel_3 | | 10 Hz . | Generic linear 0-5 V | | • V .1 | • 0.0 | 5.0 |) |
| 4 | T Disabled | Channel_4 | | 10 Hz . | AIRBOX pressure sens | or - X055NAB01 | - mbar | . 0 | 5 | |
| 5 | Cisabled | Channel_5 | | 10 Hz . | AIM Lambda LCU-ONE | (0,65 - 1,6 la | | .00 | 5.0 | 1 |
| 6 | Cisabled | Channel_6 | | 10 Hz . | Generic linear 0-5 V | | • V .1 | • 0.0 | 5.0 |) |
| 3 | Disabled | Channel_7 | | 10 Hz . | Generic linear 0-5 V | | - V .1 | • 0.0 | 5.0 |) |
| _8 | Cisabled | Channel_8 | | 10 Hz 🧵 | Generic linear 0-5 V | | - V .1 | • 0.0 | 5.0 |) |
| LC_GEAR | Cisabled | Calculated_Gear | | 10 Hz | Calculated Gear | | | 0 | 9 | |
| CI I | F Enabled | LatAcc | | 10 Hz 🔄 | Lateral accelerometer | | g .01 | -3.0 | 0 3.0 | 90 |
| S_TMP | Enabled | Datalogger_Temp | | 10 Hz 👱 | Cold joint | | *C | • 0 | 50 | |
| п | F Enabled | Battery | | 1 Hz 👱 | Battery | | ¥.1 | 5.0 | 15 | .0 |
| L1 | F Enabled | ECT | | 10 Hz 👱 | Temperature sensor | | * | - 0 | 13 | 0 |
| 1,2 | Enabled | GEAR | | 10 Hz | Gear sensor | | | 0 | 7 | |
| ور | Enabled | MODESEL | | 10 Hz . | Raw value | ••••••••••••••••••••••••••••••••••••••• | | 0 | 3 | |

• Activate the drop down menu pressing the arrow button circled in the image above and select the fuel used by the vehicle.

| Mu | ltiplier to calculate AFR from lam | bda |
|----|--|------------------|
| | (14.57) Gasoline 🗸 | Add custom value |
| | (14.57) Gasoline | |
| | (15.50) LPG (Propane) (6.40) Methanol | |
| | (9.00) Ethanol | |
| | (17.20) CNG | - |
| | (14.60) Diesel | |



• In case the fuel used by the vehicle is not included in the database (and **only in case its stoichiometric value is known**) press the button "Add custom value" and the window here below appears.

| Custom multiplier value | | | | |
|------------------------------|-------------|---|-------|-------|
| Custom multiplier value list | New value | Legend for new v | value | |
| | selec fr | emove cted item om list <u>S</u> ave | • | ancel |

- Insert the new value and the test to match. Press "Add new item to the list" button and then "Save" button.
- The fuel is now available in the drop down menu: select it.



3.2 – LCU-ONE Analog custom configuration

In case calibration curve default points have been modified it is necessary to configure LCU-ONE Analog using **Lambda Caonfigurator** software.

Warning: to correctly configure LCU-ONE Analog, please ensure you have installed a software version 1.00.07 or later.

To configure **LCU-ONE Analog** run the software. The following window appears.

| Lambda controller configur | ation Online values from lambda controller |
|--|---|
| Connected to | Color options |
| Device type | Analog output for lambda (or AFR) values 5 |
| N.D. | 4.8 |
| , Device ID number | Vot 3 2.5 |
| N.D. | |
| Firmware version | |
| Restore default lambda settings Transmit lambda configuration | (AFR = Air Fuel Ratio = Pounds of air / pound of fuel) Use: Lambda Volt vs. lambda curve points 1.95 Volt at Lambda 1.95 Volt at Lambda 1.65 From output: Volt 3 0 0.65 1.9 From output: Volt 1.9 Volt at Lambda 1.6 From output: Volt 1.5 or high impedance |
| Configuration | Save lambda settings |

This is software main window. It is made up of two layers:

- Lambda controller configurator: it shows analog output graph (central) and allows the user to configure LCU-ONE Analog, read its configuration and transmit a new one, restore default Lambda settings, import and export the configurations and update LCU-ONE Analog firmware.
- Online values from Lambda controller: it shows LCU-ONE Analog-PC connection status.



3.2.1 – Preliminary operation

Lambda Configurator software, unlike all other AIM software, contains **LCU-ONE Analog** firmware. This is why we recommend you to always check our website <u>www.aim-sportline.com</u> to ensure the software release installed is the latest available. If not, please download latest release and follow carefully this procedure:

- connect LCU-ONE Analog to the PC
- read logger firmware version written in the case on the left of the central graph
- press "Upgrade Firmware" button
- this message appears:

| LambdaCtrl | \mathbf{X} |
|------------|---------------------|
| | 'E to Vers. 25.11 ? |
| Ves | No |

if the firmware version offered (in the figure the system offers firmware version 25.10) is more recent that the one installed on LCU-ONE Analog (supposing the one installed is version 25.08), press "Yes" and upgrade the controller firmware

3.2.2 – Configuring Lambda controller

| 🚵 AlM - Lambda Cont | figurator 📃 🗖 🔀 |
|-----------------------------|---|
| Lambda controller configu | ration Online values from lambda controller |
| Connected to | Color options |
| Device type | Analog output for lambda (or AFR) values |
| LCU - ONE ANALOG | 4.8 |
| Device ID number | Volt 3 15 0 |
| Firmware version | 0 0.65 1 1.6 2 Lambda |
| 25.11 | |
| A Restore default lambda | (AFR = Air Fuel Ratio = Pounds of air / pound of fuel) Use: Lambda AFR Multiplier to calculate AFR from lambda (14.57) Gasoline Add custom value |
| Transmit Iambda | Volt vs. lambda curve points Analog output value in particular conditions |
| configuration | 1.95 Volt at Lambda 0.65 Warmup output: Volt 3 or high impedance 🗆 |
| Read lambda | 4.8 Volt at Lambda 1.6 Error output: Volt 1.5 or high impedance |
| Upgrade Firmware | Save lambda settings |
| Select language | CALENIT |



At the centre of the window are configuration panels.

| (AFR = Air Fuel Ratio = Pounds of air / pound of fuel) | Multiplier to calculate AFR from lambda |
|--|--|
| Use: Lambda AFR | |
| – Volt vs. lambda curve points – | Analog output value in particular conditions |
| 1.95 Volt at Lambda 0.65 | Warmup output: Volt 3 or high impedance 🗂 |
| 4.8 Volt at Lambda 1.6 | Error output: Volt 1.5 or high impedance |

The first operation to perform is selecting the used fuel in a pop up menu.

| (14.57) Gasoline | Add custom value |
|----------------------|------------------|
| 14.57) Gasoline | |
| 15.50) LPG (Propane) | |
| 6.40) Methanol | |

In case used fuel is not included in the database and **only in case its Stoichiometric value is known** press "Add custom value" button and the window shown below appears.

| Custom multiplier value | |
|------------------------------|--------------------------------|
| Custom multiplier value list | New value Legend for new value |
| 1 | |

Fill in the window with Multiplier value and related legend. Press "Add new item to list value" and then "Save" button.

Likewise, selecting a multiplier from the left box labelled as "Custom multiplier value list" and pressing "Remove selected multiplier from the list" button a multiplier will be removed.



Afterwards it is possible to work on the other parameters.

| (AFR = Air Fuel Ratio = Pounds of air / pound of fuel) | Multiplier to calculate AFR from lambda (14.57) Gasoline Add custom value |
|--|--|
| Use: Lambda AFR | |
| Volt vs. lambda curve points | Analog output value in particular conditions |
| 1.95 Volt at Lambda 0.65 | Warmup output: Volt 3 or high impedance 🥅 |
| 4,8 Volt at Lambda 1.6 | Error output: Volt 1.5 or high impedance |

"Use: Lambda/AFR" these buttons allow the user to decide whether showing Lambda values or AFR (Stoichiometric) ones. The appearance of the panel below depends on this choice; here down are the panels showing Lambda values (left) or AFR (right).

| Volt vs. lambda curve points | | | – Volt vs. lambda curve points | | |
|------------------------------|----------------|------|--------------------------------|-------------|-------|
| 1.95 | Volt at Lambda | 0.65 | 1.95 | Volt at AFR | 9.47 |
| 4.8 | Volt at Lambda | 1.6 | 4.8 | Volt at AFR | 23.31 |

The coloured button placed on the left of the cases indicates the colour of this value on the central graph. In the example the value is showed in light blue.

Once decided which values to show, just fill in the cases.

When all the values have been inserted the configuration has to be transmitted to **LCU-ONE Analog** pressing "Transmit lambda configuration" button, placed in the left keyboard.

The system will show a confirmation message. In case **LCU-ONE Analog**-PC connection is not ok the system shows an error message (right figure).

| Lambda Configurator 🛛 🔀 | | | |
|-------------------------|---------------------------|--|--|
| ٩ | Configuration transmitted | | |
| | ОК | | |

| Lambda Configurator 🛛 🛛 🔀 | | |
|---------------------------|---------------------------------|--|
| ⚠ | Lambda controller not connected | |
| | ОК | |



3.2.3 – The keyboard

On the left of the window are some buttons:

- "Restore default lambda settings": allows the user to restore default settings on **LCU-ONE Analog**.
- "Transmit lambda configuration": allows the user to transmit the configuration to the device
- "Read Lambda configuration": reads the configuration from the connected device
- "UpgradeFirmware": allows the user to upgrade the firmware of its device.

Bottom central are these buttons:

- "Save Lambda settings": allows the user to export Lambda configuration
- "Load lambda settings": allows the user to import a Lambda configuration and transmit it to the device

In the lower part of the window are thrre buttons:

- "Select language": allows the user to change the language
- "OK": allows the user to save the set parameters
- "Exit": allows the user to quit discarding changes.

3.2.4 – Informative panels

On top left of the software main window a series of panels shows the characteristics of the **LCU-ONE Analog** connected to the PC. These panels are different depending if the device is connected or not.

Here below you see (left) the panels with the controller connected to the Pc and (right) the same panels with the controller not connected to the PC.

| Connected to | Connected to |
|------------------------|------------------|
| COM 1 | NOT CONNECTED |
| Device type | Device type |
| LCU - ONE ANALOG | N.D. |
| Device ID number | Device ID number |
| 1002225 | N.D. |
| Firmware version 25.11 | Firmware version |

- Connected to: PC serial port
- Device type: **LCU-ONE Analog** (controller has been recognised)
- Device ID number: univocal serial number of the device
- Firmware Version: firmware version installed on the device.

If LCU-ONE Analog is not correctly connected to the Pc or if it is not connected at all, the system shows a "not connected" message and all information concerning the controller are set on N.D. (Not available)



3.2.5 – The analog output graph



The "analog output graph" shows output tension values of the controller in correspondence of the measured Lambda values. Graph colours are customizable. Pressing "Colour options" button the window shown below appears:



Pressing each button a colour panel will appear showing all the available colours for that characteristic of the graph. Selecting the desired colour and confirming the choice graph colours will change.



Chapter 4 – Online values from Lambda controller.

| À AIM - Lambda Configura | ıtor - 1.00.07 | | X |
|--|--------------------------------------|---------------------------------|----------|
| Lambda controller configuration | Online values from lambda controller | | 1 |
| Connected to | Lambda to AFR multiplier | 14.57 | |
| COM 1 Device type LCU - ONE ANALOG Device ID number | Lambda measure | Battery measure [Volt] 12.61 | |
| 1002225 Firmware version 25.11 | Temperature measure | | |
| Lambda sond status | i 🥥 | WARMUP: OFF | |
| | | | |
| | | Racing Data Power | , |
| Select language | | V <u>O</u> K Exit | |

This panel shows controller status. The user is only allowed to set Lambda/AFR and temperature unit of measure for the values shown in this panel.



Appendix – Part Number and technical drawings

"A" – Part number of LCU-ONE Analog

| Complete kit with cable for MyChron3 XGLog | X08LCU04XG |
|--|------------|
| Complete kit with cable for MyChron3 Plus/Gold Auto/Moto | X08LCU04PG |
| Lambda Probe Bosch LSU 4.9 | X05LSU490 |

"B" – Technical drawings





N/ev. / Rev. N. Description Data / dato Firma/ Sgn — Contr. da/ Ckd. by LCU-ONE Analog pinout Lamitida. Haine sa Lambea Combrellar Analog harness Power Haness (max_lenght100 cm) Π П ٢ ٢ ۲ Ð ٩ ٢ Power harness Analog Harness Lambdia harness V batte iy 1 IP+ red Lambda O 🕇 1 GND GND 2345 IP-WS black GND RS232 RX PC RS232TX PC 2 3 4 H-H+ black Rcal 6 VS+ RE/RE Otá / Oty Material o/ Material N. articol o/ Itom N. Contr. da / Ckd. by Kopro vato da / App io vo diby Data / Data Scala / Scalo Progetato da / Designed by Norre file/ Filenarre LI. Titolo / Title Pinout LCU-ONE An alog N. disegno / Drawing N. Riv. / Riv inglia / Sheet 1 di 1 Racing Data Power