LCU–ONE CAN connected to **MXL-EVO3 Pro/Pista User Manual**





Racing Data Power



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Chapter 1 – LCU-ONE

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 carburettor 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.

It is necessary to heat the wide band Lambda probe so that it works properly and is not poisoned with exhaust gas. **LCU-ONE** precisely manages the probe heater so to keep temperature value in the optimum working range.

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

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

Warning: disrespect of these precautions can cause shocks, burnings or explosions.

1.1 – LCU ONE part number

LCU-ONE Kits part numbers are:

- Controller LCU-ONE (complete kit with Lambda probe) X08LCU03K0
- Lambda probe BOSCH LSU 4.9 X05LSU490



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 supplied bracket.

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

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 to the user.

Solvents or additives should not be used to clean the probe connector. To protect the probe we would suggest to remove it 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 verified by the user with specific tests.



Chapter 3 – Connection with MXL – EVO3 Pro/Pista

LCU-ONE CAN can be connected to all MXL and to EVO3 Pro/Pista.

Warning: connect LCU-ONE CAN to MXL or EVO3 Pro/Pista when both are OFF.

3.1 – Connection of LCU-ONE CAN



To connect Lambda controller only, the connection scheme is the one showed above. To protect Lambda Controller we would suggest to insert a 10 A fuse for each Controller in series between external battery and Lambda controller.

LCU-ONE CAN is to be powered – like the logger – by the engine master switch.

As far as connection with the loggers is concerned, refer to each system user manual.



In case more than one **LCU-ONE** has to be connected, for a better engine control (one probe for each engine bank or even one probe for each engine cylinder), the peripherals connection scheme to follow is shown below:



Each Lambda controller has to be connected to the battery. We would suggest to protect each Lambda controller with a 10A fuse. When **MXL/EVO3** is switched off all peripherals are automatically switched off.



3.2 – Connection of LCU-ONE CAN + GPS MODULE



In case Lambda controller is to be connected with other CAN peripherals, connection scheme is the one shown above.

We would suggest to insert a 10 A fuse in series between external battery and Lambda controller to protect the latter.

As far as connections with the logger is concerned, refer each system user manual.



Chapter 4 – Configuration on MXL – EVO3 Pro/Pista

To be used with **MXL/EVO3**, **LCU-ONE CAN** needs to be configured through **Race Studio 2** software. Refer to **Race Studio Configuration** user manual for further information about the software and to the loggers manual for further information about their configuration.

It is suggested to configure **LCU-ONE** keeping it connected and switched on.

Run the software and select the desired logger: **MXL** or **EVO3 PRO/Pista**. The figure shown below appears. Select "**CAN-Expansions Configurator**" layer. In case of very first configuration the layer appears empty as shown below.



Press "Add Expansion" and the window here below on the right appears:

Select LCU-ONE CAN (only CAN). The fields under the keyboard enables, press "Get serial number from a connected expansion" and the system gets the serial number of the connected **LCU-ONE**. It is also possible to insert this information manually keeping it from **LCU-ONE**.

This operation is to be repeated as many times as many LCU-ONE are connected.

The layer will be modified adding as many new layers as many LCU-ONE have been added.

Add expansion configuration		🔼
Select the expansion type		
Channels Expansion	Devid (Slave expansion)	LCU-ONE (CAN only or CAN + analog output)
LCU-CHE CAN (CAN only)	TCHUB (+thermocupie expansion)	
LCC	n (o characters max.)	
Serial number of the expansion	(5.N.)	al number from a connected
	Get sen	expansion
	<u>OK</u>	



ent configura		/pe Ecu	Vehicle		Available time	Time with GPS	Total frequency	Master fr		Expansions fre	qu Tot. Expan
FAULT	MXL PISTA	None - None			7.35.51 (h.m.s)	3.42.05 (h.m.s)	152 (Hz)	131 (Hz)	equency	21 (Hz)	qu Tot. Expan
AULT	MAL PISTA	None - None	e DEFAUL	LI	7.55.51 (1.11.8)	5.42.05 (ri.ni.s)	152 (HZ)	131 (HZ)		21 (HZ)	1
CC - LCLI-ON	NE CAN LLCCD1 - L	LI-ONE CAN									
	NE CAN LCC01 - L expansion configura Serial number of e	tion (6 characters m	max.) LCC			Get serial number f connected expan					
Name of (expansion configura Serial number of e	tion (6 characters m	max.) LCC	Sampling f	irequency Sensor ty	connected expan	sion	Measure unit	Low s	scale	High scale
	expansion configura Serial number of e abled Chann	tion (6 characters m «pansion (S.N.) I name	max.) LCC	Sampling f		pe	sion		Low s		High scale 2.00
Name of e	expansion configura Serial number of e abled Channa d LCC_La	tion (6 characters m cpansion (S.N.) I name mbda	max.) LCC		requency Sensor ty	pe ignal	sion	ambda .01			-
Name of e	expansion configura Serial number of e abled Chann d LCC_La d LCC_AI	tion (6 characters m cpansion (5.N.) I name mbda R	max.) LCC	10 Hz	requency Sensor ty	pe ignal	sion	ambda .01	• 0.00		2.00
Name of e	expansion configura Serial number of e sabled Channi d LCC_La d LCC_La	tion (6 characters m cpansion (5.N.) Il name mbda R mTmp	nax.) LCC	10 Hz 10 Hz	requency Sensor ty Lambda s	pe ignal ure sensor	sion	ambda .01 VF .01	0.000.00		2.00 20.00

In case serial number has not been get, press "Get serial number from a connected expansion" button.

Warning: getting LCU ONE serial number is mandatory to transmit the configuration to the logger.

LCU-ONE layer is shown above.

On top

Name of expansion configuration (6 characters max.) and serial number fields. Inserting a configuration name the layer label is modified live. As far as serial number is concerned, see previous paragraphs.

Central in the page a table shows LCU-ONE channels. The table has 7 columns.

Enabled/Disabled: shows the channel status (enabled/disabled) and can be modified checking or un-checking the related checkbox. LCC_lambda (lambda value) and LCC_AFR (AFR value) channels are enabled by default.

Channel name: shows the channel name and can be modified double clicking on the cell that becomes editable.

Sampling frequency: shows the channel sampling frequency and can be set selecting the desired value from the drop down menu that appears double clicking on the cell (accepted values are from 1 to 50 Hz).

Sensor Type: shows the sensor installed on that channel and cannot be modified.

Measure Unit: shows the selected unit of measure of that channel and can be modified double clicking on the cell.

Low/High scale: shows the channel high and low scale and can be modified double clicking on the cells, that become editable.

Under the table is "Multiplier to calculate AFR from lambda" field. It allows the user to change the used fuel and to insert a new one. Select the used fuel to see its AFR value.



In case a fuel not included in the database is being used 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
		ew item to list
	select fro	move ted item im list
	_ ≥	ave <u>C</u> ancel

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

Likewise, select a multiplier from the left box labelled as "Custom multiplier value list" and press "Remove selected multiplier from list" button to remove a multiplier.



Once enabled/disabled the channels, it is possible to show Lambda channels on the display depending on the logger and on the connected peripherals. In case of an **MXL**, Lambda channels can be shown setting them in "System Configuration" layer. In the example below **LCU-ONE** enabled channels are: LCC_Lambda, LCC_AFR and LCC_diagnosis and each one can be shown in a field of the display. The example shows the three channels set on page 1 and 2 of MXL (red box).

🚟 System manage	er								
Current configuration	smit	Receive		CAN-Net info	Set a	acquisition system time	Smart	yCam Functions setting	
Installation name	Data logger type	Ecu	Vehicle name	Available time	Time with GPS	Total frequency	Master frequency	Expansions frequ	Tot. Expansi
DEFAULT	MXL PISTA	None - None	DEFAULT	7.35.51 (h.m.s)	3.42.05 (h.m.s)	152 (Hz)	131 (Hz)	21 (Hz)	1
Select configuration	Channels Sustem	configuration CAN-E	mansions configurator	1					
	System System	configuration and a set of							
Rom			Shift Li					Use GPS Lap T	ïmer
AIM sensor	Multiply factor	/ 1	O O	O Channe	Speed_1		~		
ECU signal	MAX value	16000			Lap		["	ack width (for GPS La	p timer precisi
Over-rev log		rev threshold 0			Obscuring	time 8			
Alarm led	None 💙 Over-	rev threshold	<u> </u>	O	(sec.)	ents 1	\square	Car/Bike	10
Gear sensor	Calculate		0		Lap segme	encs L	1-LAP		
None			<u> </u>		Sho	w lap time		Boat	100
Potentiometer	Calculated with signal: Char		O		📄 💭 Sho	w odometer		Specific	10
Channel 8	Highest gear r	a second s			🦾 Sho	w running lap time			
ECU	highest gear i			00000	Condition	enabling checked alar	rms		
					Speed_1		> 0		
Channel for alar	Con	ditioned	2 4 5 1	- / rem		16 1	Conditioned		
	Threshold		GEAR	° 66 /			reshold		
Channel_1	✓ ≥ 0		URTER 🤳 P DI	L LAP34	Channel_2	· · · · · · · · · · · · · · · · · · ·			
Channel_3	0	18	4S 3.	: 🔨 (8:35	Channel_4	🗸 🔁 C	O Off		
Channel_5	0	off 📲 🖊 🖁	EST LAP	118,173	Channel_6	🗸 🔽 (Off		
101									
Link alarm	n to measure fields	90 5			MIXE				
Measur		name				leasure	Short name		
Field 1 - always di	splayed	м	Enable st	atic string		ays displayed	CH_2		
LCC_Lambda	×			Jac baring	Channel_2	~			
Field 3 - page 1					Field 4 - pag		CH_4		
LCC_AFR	V AF				Channel_4	*			
Field 3 - page 2		Tex	t1		Field 4 - pag				
LCC_Diagn	V DI	AG			Channel_6	~	CH_6		
									_
									-
•									

In case of an **EVO3**, data visualisation is possible only connecting the logger to a **Formula Steering Wheel** or to a **MyChron3 Dash** and the channels to show are set in the display configuration as shown below.



Tr	ransmit	, Receive		CAN-Net info	Set 💿	acquisition system time	Smart	tyCam Functions setting	
rrent configuration stallation name	Data logger type	Ecu	Vehicle name	Available time	Time with GPS	Total frequency	Master frequency	Expansions frequ	Tot. Expan
FAULT	EV03 PRO	MARELLI - DALLA	DEFAULT	7.40.54 (h.m.s)	5.01.17 (h.m.s)	302 (Hz)	281 (Hz)	21 (Hz)	1
elect configurati	tion Channels System	configuration Display	CAN-Expansions c	onfigurator					/
	Available displays Form	mula Steering Wheel	~						
Shift Lights									
Led 1	Led 2 Led 3		Led 5						
0									
<u> </u>	0	0	,						
	0 LIGHT ► 1 2 3			y Page 1 - Channels ar	nd alarms Display	y page 2 - Channels ar	nd alarms —		
		4 5		Ċ	nd alarms Display		nd alarms		
	LIGHT ► 1 2 3	4 5	Field 2	LCC_Lambda LED	Field 2	Channel_4 LED			
SHIFT	LIGHT ► 1 2 3	4 5	Field 2 HIGH	LCC_Lambda LED None V 0	Value Field 2	Channel_4 LED None 0	~		
SHIFT	LIGHT ► 1 2 3	4 5	Field 2 HIGH	LCC_Lambda LED None V 0 None V 0	Field 2 Value HIGH	Channel_4 LED None V 0 None V 0	Value		
SHIFT CONCEPTION	N 10,00 70° L 3	4 5	Display Field 2 HIGH LOW Field 1	LCC_Lambda LED None V 0 None V 0	Field 2 Value HIGH LOW	Channel_4 LED None V 0 None V 0 Channel_3	Value		
SHIFT	N 10,00 70° L 3	4 5	Field 2 HIGH D 3	LCC_Lambda LED None V 0 None V 0 LCC_Diagn LED	Field 2 Value HIGH	Channel_4 LED 0 None V 0 Channel_3 LED	Value		
SHIFT CONCEPTION	N 10,00 70° L 3	4 5 1 12 20.35	Display Field 2 HIGH LOW Field 1	LCC_Lambda LED None V 0 None V 0 LCC_Diagn LED None V 0	Field 2 Value HIGH LOW Field 1 Value	Channel_4 LED None V 0 Channel_3 LED None V 0	Value		

Note: LCC_diagnosys channel shows LCU-ONE working status and can show up to four messages:

- 0: status OK
- 1: probe not connected
- 2: +12V short circuit
- 3: GND short circuit

The configuration is now ready to be transmitted to the logger.

Warning: the configuration is to be repeated on all LCU-ONE connected to the logger.

Once all parameters have been set and fields assigned, the configuration needs to be transmitted to the logger pressing "Transmit" on **Race Studio 2** top keyboard. If the transmission is ok no message is shown. If, on the contrary, **LCU-ONE** serial number has not been get, the window here below appears. It tells the user that no serial number has been assigned to the connected expansion. Close this window pressing "Cancel" and get the expansion serial number as explained in the previous pages.

Ex	pansion configuration probl	ems		Σ	<
т	o transmit configuration, following pr	oblems have to be fixed:			
Γ	Name of expansion configuration	Expansion type	Expansion Serial Number (S.N.)	Status	1
	LCC	LCU-ONE CAN		No serial number assigned	I
					1
1					
				- Cancel	



Chapter 5 – Data Visualisation on MXL/EVO3

5.1 – Data Visualisation on MXL

Lambda channels visualisation on **MXL** works exactly like the visualisation of any other **MXL** channel. To switch from one page to the other use "MEM/View".

Refer to **MXL** user manual for further information. In the right figure lambda value is 0.95 and assigned Short Name is LAM.



Switching **MXL** on, Lambda controller is recognised at start-up and probe Warm-Up procedure starts. During this period, the controller takes the probe to its working temperature (until around 780 $^{\circ}$ C – 1436 $^{\circ}$ F).

During warm-up (around 20-30 seconds), displayed lambda value is 1.00.

When the probe is 100% working, displayed value turns, with the engine off, into 1.60 (free air value).

5.2 – Data Visualisation on EVO3

Lambda channels visualisation on **EVO3** works exactly as the visualisation of any other **EVO3** channel and is thereby possible only if the logger is connected to a display.

The only displays that show Lambda value are **MyChron3 Dash** and **Formula Steering wheel**. In the right figure Lambda value is 0.95 and the field is labelled as " λ "



Switching **EVO3** on, Lambda controller is recognised at start up and probe Warm-Up procedure starts. During this period the controller takes the probe to its working temperature (until around 780 $^{\circ}$ C – 1436 $^{\circ}$ F).

During warm-up (around 20-30 seconds), displayed lambda value is 1.00.

When the probe is 100% working, displayed value turns, with the engine off, into 1.60 (free air value).



Chapter 6 – Data Analysis with Race Studio Analysis

During data analysis, the presence of Lambda controller adds as many channels as the number of **LCU-ONE** channels enabled to Measures and laps toolbar (as shown in the figure below):

Lambda : shows lambda value recorded during the session;

Lambda_Temp: indicates the probe internal temperature while working;

Misure e giri								
Misure Giri Mod	elli							
LONATO NICO		13	14					
Engine		10448 🚺	9819					
Datalogger_Temp		2 🚺	2					
Battery		11.9	11.9					
Lambda		0.92 🚺	0.96					
Lambda_Temp		778 🚺	783					

To better analyse carburettor values, it is suggested to show XY diagram of Lambda probe with RPM values on abscissa axle and Lambda values on ordinate axle. In this way a more immediate reading of carburetion status is available.





Appendix – Technical drawings









LCU-ONE CAN pinout

