ideas make future

LAMBDA controller
type LCP90

designed for LAMBDA sensor

LSU4.9 & LSU4.2

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Brief description

The product LAMBDA controller type LCP90 works with a wideband Lambda sensor type LSU 4.9 and LSU 4.2 (replacement LSM 11) with extended function for PID mixture regulation using a Stepper motor control. The product is suitable for measuring and regulation the lambda value, the ratio of AFR and O2 in combustion engine cogeneration units, boilers burning gas or biomass or other applications.

LAMBDA controller is based on circuit BOSCH CJ125 which serves basic function of oxygen sensor along with supporting microprocessor for filtering and control. Microprocessor also provides PID lambda regulation by Stepper motor control, Analog output – AO, diagnostic interface USB and CANbus in protocol SAE J1939 or CANopen.

Lambda heater is controlled by PID regulator and the resistance of measuring cell (Nerns Cell) with auto-off option according to engine speed received from CANbus / J1939.

LAMBDA controller processes and visualizes data about Lambda mixture – λ, Oxygen – O2, Ratio – A/F, Sensor temperature – T [°C], Supply voltage – U[V], Analog output – AO [V/mA] Actual step of stepper motor [-] and Engine speed – RPM (from CANbus / J1939).

Main Features

- ✔ Supply voltage range 7 to 36 V (12V/24V)
- ✔ Consumption 15 W (Lambda heater and Stepper motor)
- ✔ Operation temperature -40 to 85 °C
- ✔ Support for Lambda sensor type: LSU 4.9 and LSU 4.2 (replacement LSM 11)
- ✔ Used BOSCH CJ125 circuit and microprocessor support
- ✔ Visualization: Lambda – λ .... 0.7 to 12.5 (± 0.1 %)

  Oxygen – O2 .... -7.5 to 20% (± 0.1 %)

  Ratio – A/F .... Gasoline, Diesel, Methanol, Ethanol E85, LPG, CNG, Hydrogen

  Temperature – T [°C] …........ -40 to 1050°C (± 3°C)

  Supply voltage – U [V] …....... 7 to 50V (± 0.5V)

  Analog output – AO [V/mA] .. 0 – 5 V, 0 – 10 V   (± 0.1 %)
  0 – 20 mA, 4 – 20 mA   (± 0.1 %)

  Digital Input DI1/DI2 .... 0 or 12/24 V

  Engine hours .... [h:m:s]

  Actual step .... 0 to 65000 steps

- ✔ PID mixture regulation by Stepper motor control (microstep 1/2, 1/8 or 1/32)
- ✔ Power source 11V inside for LAMBDA heating and Stepper motor supply
- ✔ CANbus support at protocol SAE J1939 or CANopen (250kbps)
- ✔ Supported connection or integration with ECU MASTER
- ✔ Galvanically isolated USB – USB protection against earth fault and EMC disturbances
- ✔ PC application – configuration and visualization measured values
- ✔ Measuring the supply voltage
- ✔ No Calibration required
- ✔ Installation standard – DIN rail 35mm
- ✔ Protection class – IP20
- ✔ Dimensions 118x101x23mm

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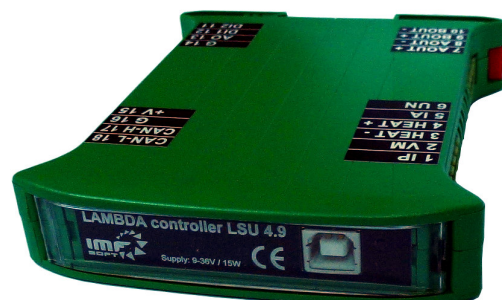
LAMBDA controller – signal description
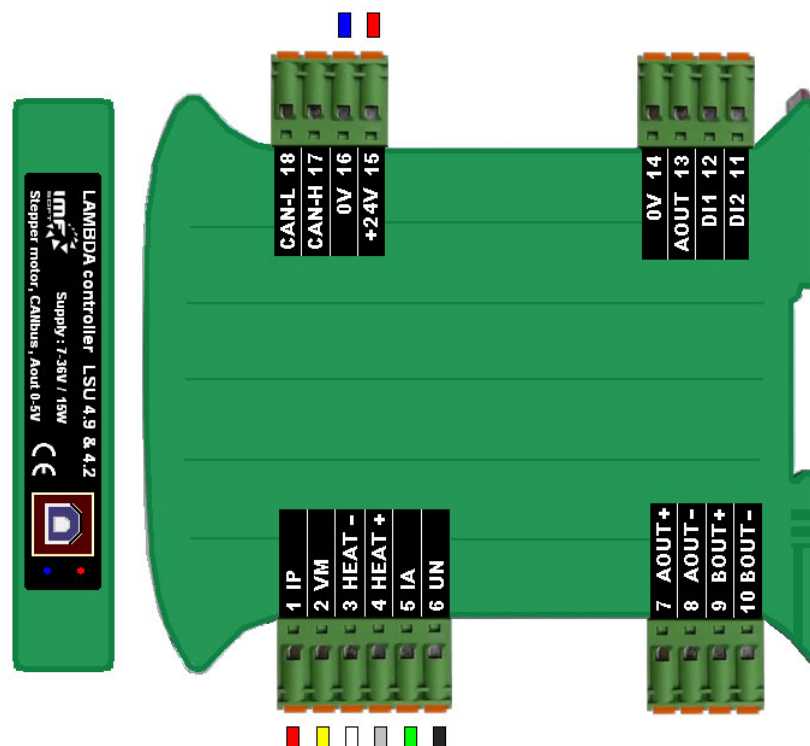
MARKING	MEANING	RANGE, ACTIVE LEVEL
+V	Power supply	7 to 36 V (12V/24V)
G	Ground supply	0V
AOUT+	Stepper motor – Signal A+	Power 11V / 1A, μ-step 1/2, 1/8 or 1/32
AOUT-	Stepper motor – Signal A-	Power 11V / 1A, μ-step 1/2, 1/8 or 1/32
BOUT+	Stepper motor – Signal B+	Power 11V / 1A, μ-step 1/2, 1/8 or 1/32
BOUT-	Stepper motor – Signal B-	Power 11V / 1A, μ-step 1/2, 1/8 or 1/32
DI1 DI2	Digital input signal	0 or 12/24 V (need active signal)
AO	Analog Output	0–5 V, 0–10V, 0–20 mA, 4–20 mA
CAN H CAN L	CAN bus	SAE J1939 / CANopen 250kbps
LSU 4.9 (LSU 4.2)		
IP (red)	Lambda LSU - pin 1 (6*)	IP/APE - pump current shunt input
VM (yellow)	Lambda LSU - pin 2 (5*)	VM/IPN - virtual ground output
HEAT- (white)	Lambda LSU - pin 3 (4*)	Uh-/H- - heating +
HEAT+ (grey)	Lambda LSU - pin 4 (3*)	Uh+/H - heating +
IA (green)	Lambda LSU - pin 5 (2*)	IA/RT - pump current control output
UN (black)	Lambda LSU - pin 6 (1*)	UN/RE - inverting input of pump

* Index of pins depends on Lambda sensor type

LED SIGNAL	MODE	DESCRIPTION
	Run	Measuring and heating function of the probe is in operation
	Sleep	Operation stopped - Heating switched off (CAN-BUS only)
	Fault	LAMBDA probe failure (Worn out - must be replaced)

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LAMBDA controller – wiring scheme

Lambda sensor - LSU 4.9

Stepper Motor
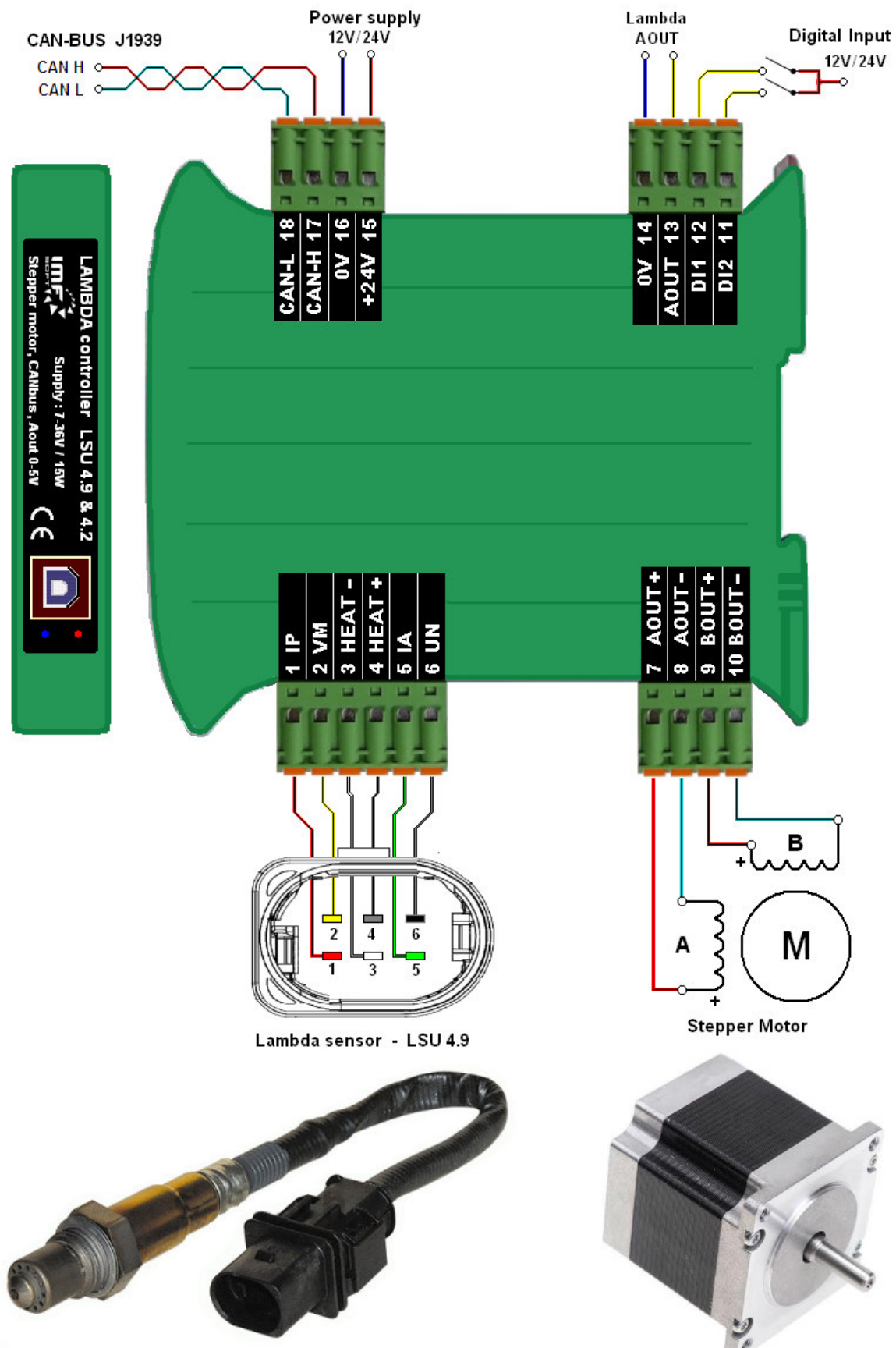
Application LAMBDA control – visualization software

Visualization is done from application LAMBDA *control* run on your PC. The application works under *Windows XP, WIN7, WIN10 or other*. Installation requires 4MB of free space at your hard disc.
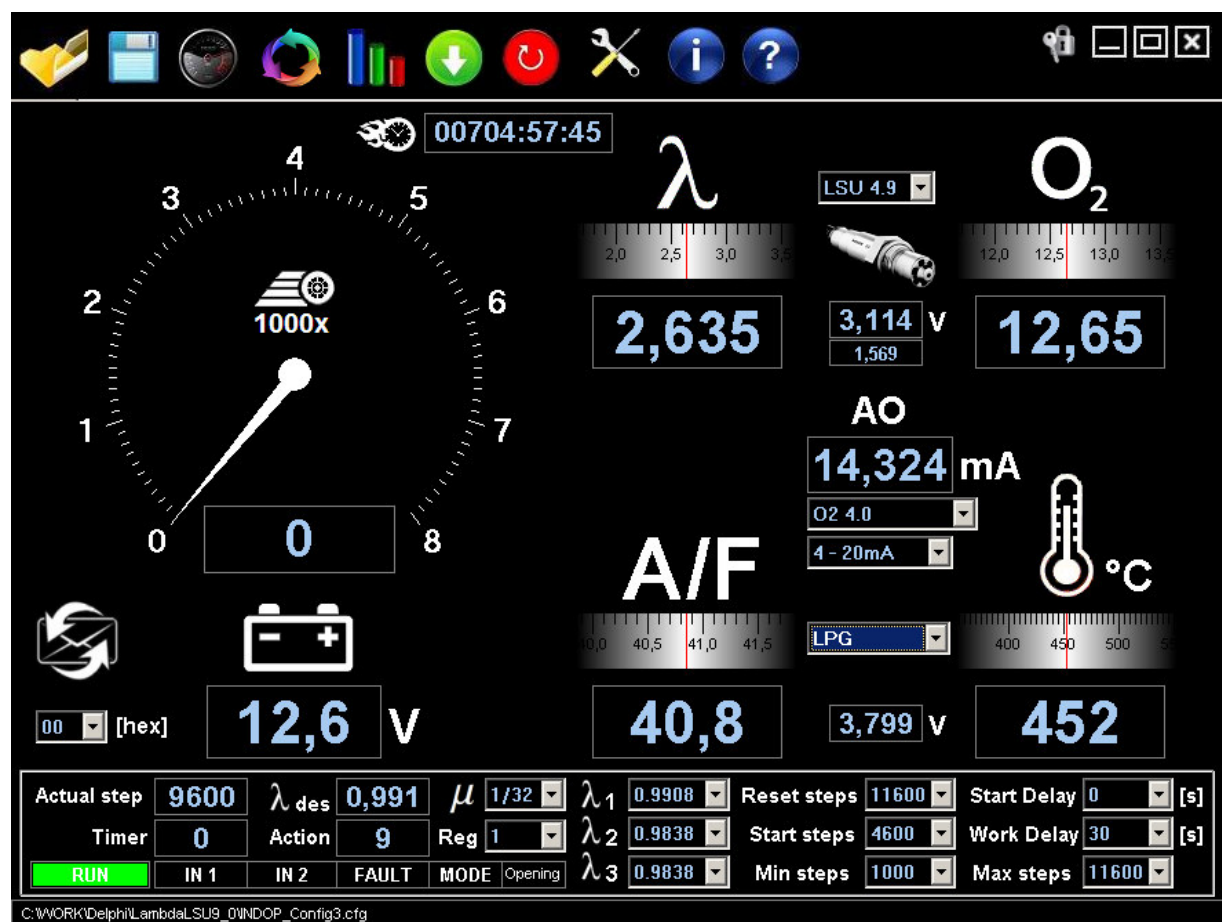
To connect lambda to PC is used USB interface. Driver for USB is included on the installation CD.

Visualized information

- – Lambda – λ
- – Oxygen – O2
- – Ratio – A/F
- – Temperature – T [℃]
- – Supply voltage – U [V]
- – Analog output – AO [V]
- – Engine hours [h:m:s]
- – Revolutions [RPM]
- – Actual stepper motor possition [-]

Run the visualization

LAMBDA control application – personalization

The visualization application allows you to import a LOGO.BMP image with dimensions of 375x310 (WxH) pixels, which will replace the speed indicator. The appearance of the application will thus approach the solution of your technology.
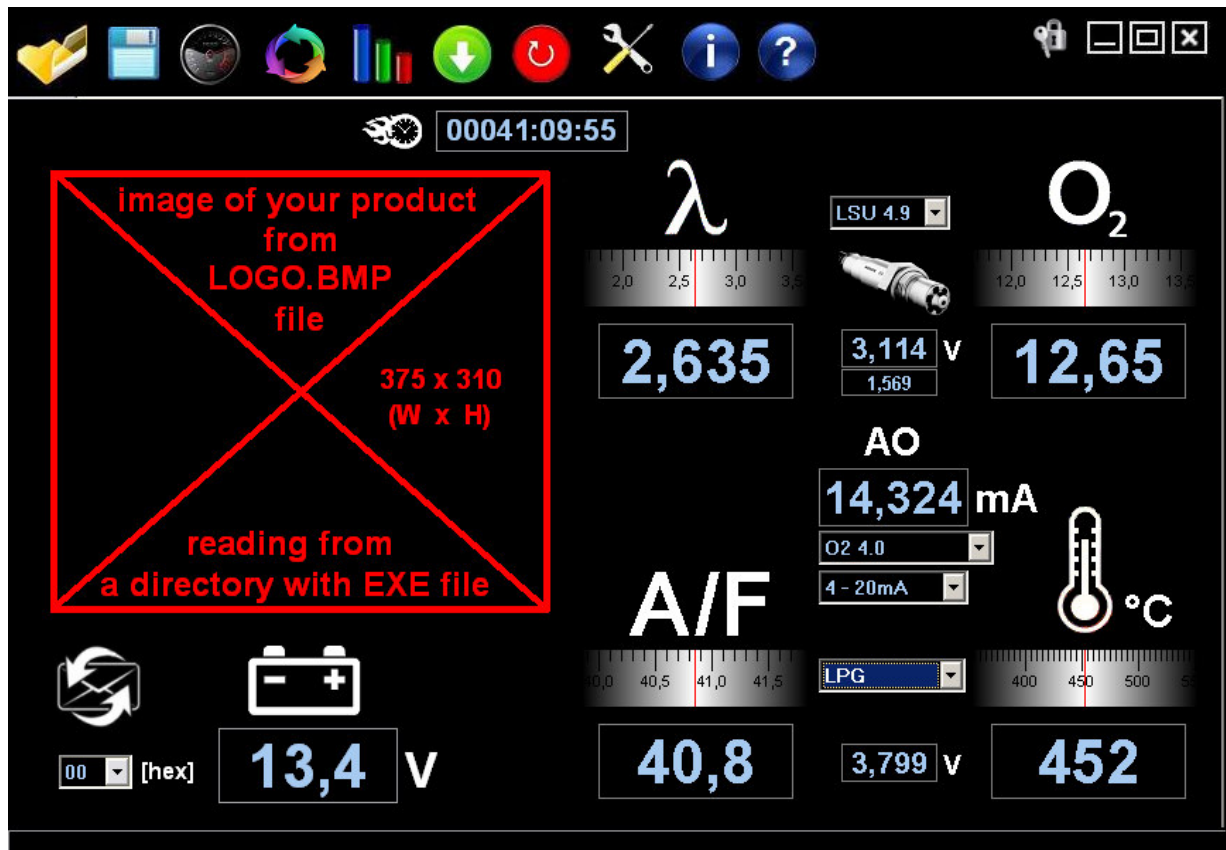
Table – AFR – Fuels

Gasoline, Diesel, Methanol, Ethanol, E85, Propane (LPG), Methane (CNG), Hydrogen

LAMBDA	O2	AFR - Air Fuel Ratio							
[-]	[%]	Gasoline	Diesel	Methanol	Ethanol	E85	LPG	CNG	Hydrogen
0,70	-7,80	10,3	10,2	4,5	6,3	6,8	10,9	12,0	22,7
0,75	-6,35	11,0	10,9	4,8	6,8	7,3	11,6	12,9	24,3
0,80	-4,76	11,8	11,6	5,1	7,2	7,8	12,4	13,8	25,9
0,85	-3,36	12,5	12,3	5,4	7,7	8,2	13,2	14,6	27,5
0,90	-1,95	13,2	13,1	5,8	8,1	8,7	14,0	15,5	29,2
0,95	-0,97	14,0	13,8	6,1	8,6	9,2	14,7	16,3	30,8
1,00	0,00	14,7	14,5	6,4	9,0	9,7	15,5	17,2	32,4
1,05	0,99	15,4	15,2	6,7	9,5	10,2	16,3	18,1	34,0
1,10	1,98	16,2	16,0	7,0	9,9	10,7	17,1	18,9	35,6
1,15	2,93	16,9	16,7	7,4	10,4	11,2	17,8	19,8	37,3
1,20	3,52	17,6	17,4	7,7	10,8	11,6	18,6	20,6	38,9
1,25	3,98	18,4	18,1	8,0	11,3	12,1	19,4	21,5	40,5
1,30	4,70	19,1	18,9	8,3	11,7	12,6	20,2	22,4	42,1
1,35	5,26	19,8	19,6	8,6	12,2	13,1	20,9	23,2	43,7
1,40	5,86	20,6	20,3	9,0	12,6	13,6	21,7	24,1	45,4
1,45	6,38	21,3	21,0	9,3	13,1	14,1	22,5	24,9	47,0
1,50	6,87	22,1	21,8	9,6	13,5	14,6	23,3	25,8	48,6
1,60	7,67	23,5	23,2	10,2	14,4	15,5	24,8	27,5	51,8
1,70	8,43	25,0	24,7	10,9	15,3	16,5	26,4	29,2	55,1
1,80	9,19	26,5	26,1	11,5	16,2	17,5	27,9	31,0	58,3
1,90	9,66	27,9	27,6	12,2	17,1	18,4	29,5	32,7	61,6
2,00	10,18	29,4	29,0	12,8	18,0	19,4	31,0	34,4	64,8
2,50	12,26	36,8	36,3	16,0	22,5	24,3	38,8	43,0	81,0
3,00	13,70	44,1	43,5	19,2	27,0	29,1	46,5	51,6	97,2
3,50	14,80	51,5	50,8	22,4	31,5	34,0	54,3	60,2	113,4
4,00	15,49	58,8	58,0	25,6	36,0	38,8	62,0	68,8	129,6
5,00	16,57	73,5	72,5	32,0	45,0	48,5	77,5	86,0	162,0

LAMBDA controller - LCP90

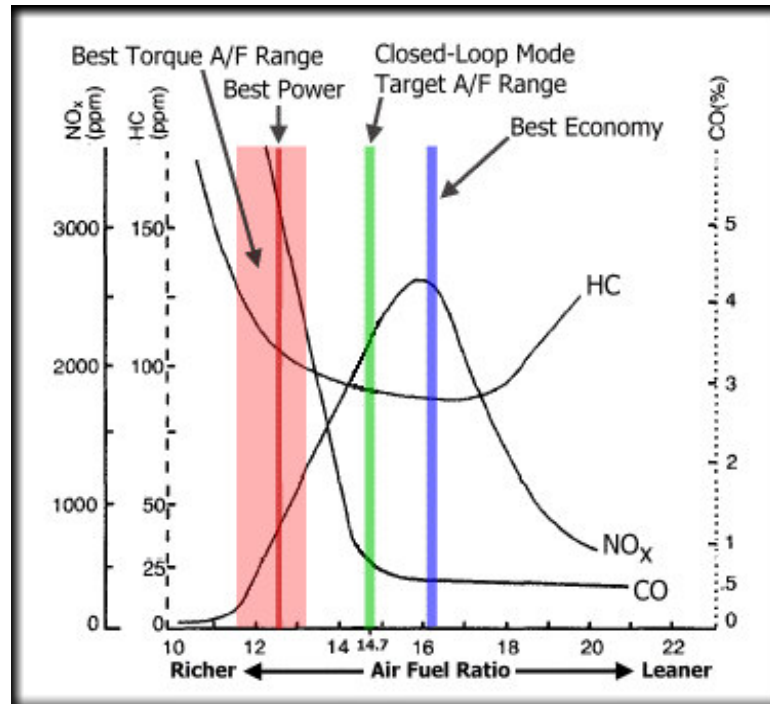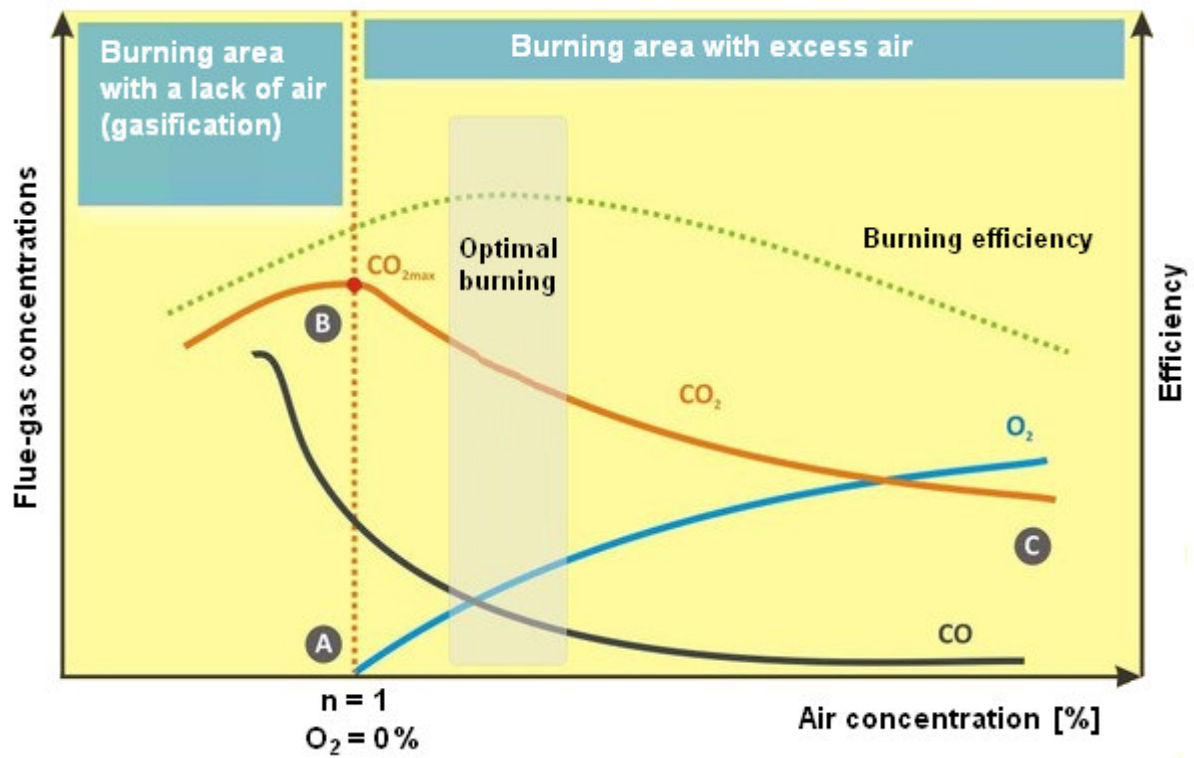## Table – Engine AFR – Power / Emissions / Economy

Table – Boilers O2 – Power / Emissions / Efficiency

LAMBDA – Analog Output – AO

LAMBDA controller is able to generate an analogue output depending on measurement of the immediate LAMBDA values. Output curve can be adjusted to five different waveforms, any further are possible to add upon your special requirement. The exact value of each voltage curves are displayed in a separate file LAMBDA_AnalogOUT (1002-0022-14).

ANALOG OUTPUT
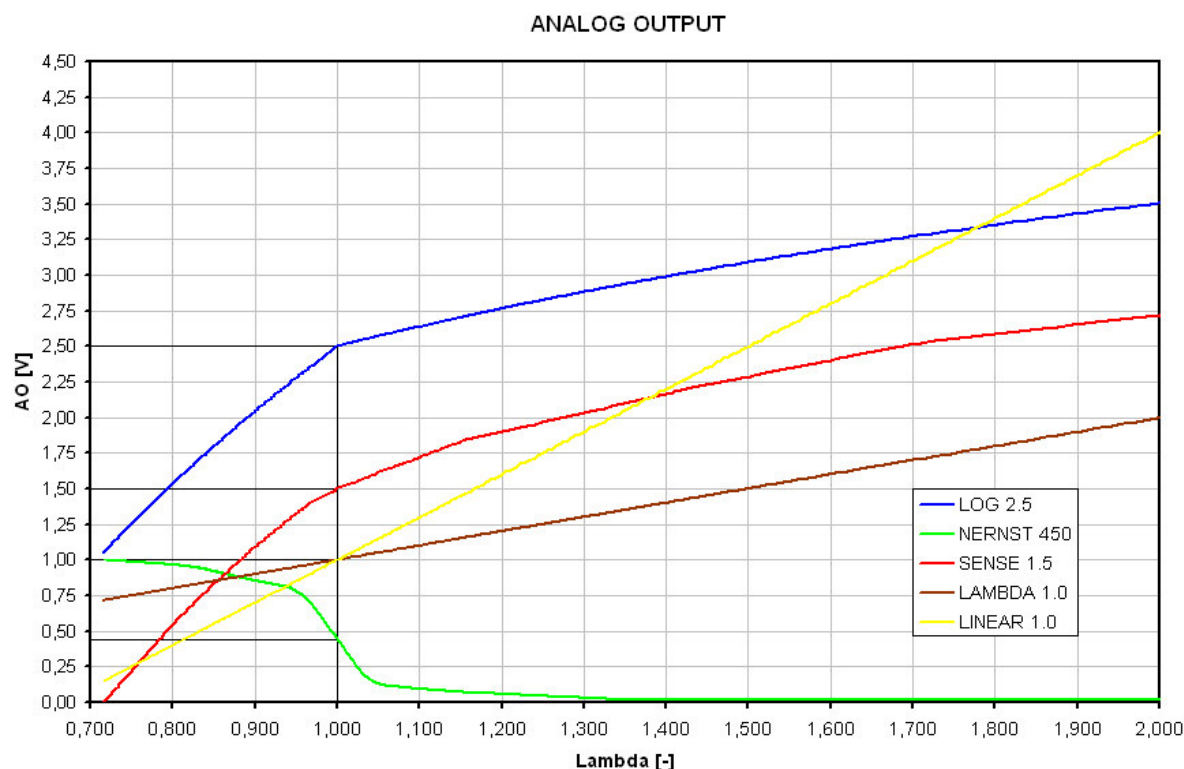
LAMBDA sensor LSU 4.9 – BOSCH 0 281 004 148 or BOSCH 0 258 017 025

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Assembly drawings

LAMBDA controller - LCP90
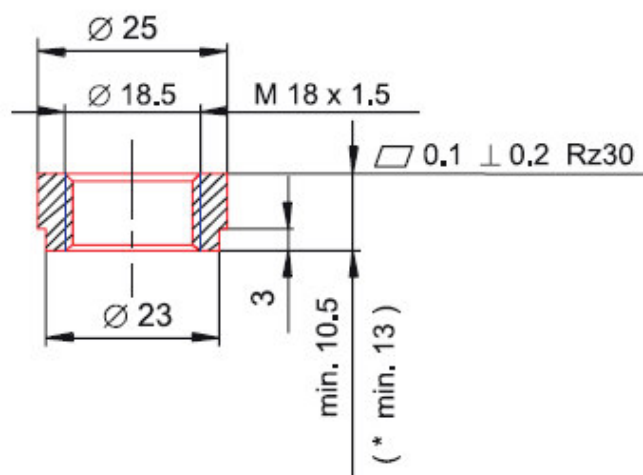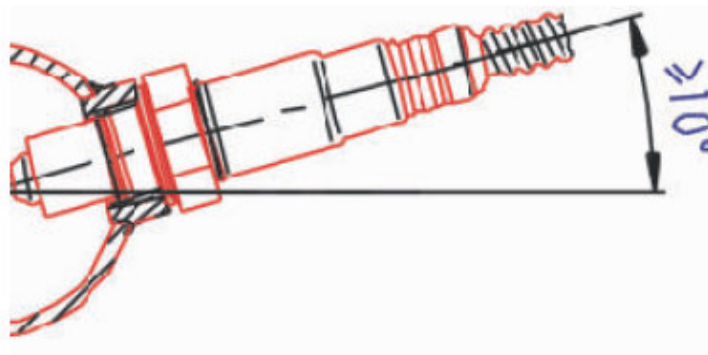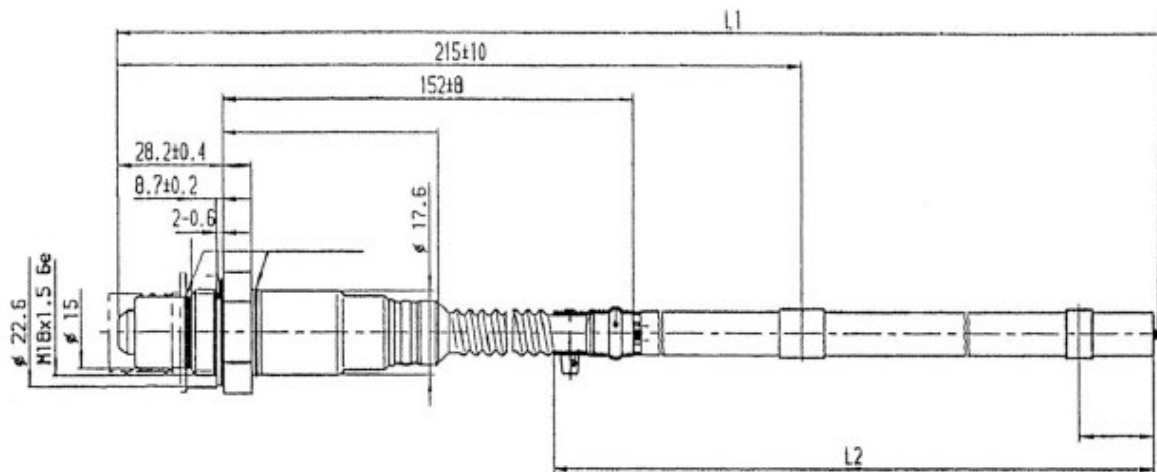
Frequently Asked Questions - FAQ

· ### *How to connect to LAMBDA controller via USB?*

The LAMBDA controller can be connected to a PC via a USB cable, where a virtual serial port is created in the PC after connection, where information about port creation and port number can be found in the device manager.

There may also be a problem with the USB driver, where the current version can be downloaded here: https://ftdichip.com/drivers/vcp-drivers/

· ### *Why measurement of LAMBDA show incorrect value?*

1) Is this a new application or has it already been used?
The oxygen sensor life-time is limited to 8,000 hours, so it may be worn.
Did you tried to replace the LAMBDA probe with a new one?
It can be damaged earlier due to dirt, corrosion or moisture
The red LED on the controller lights up if detect fault.

2) Is the cable for connecting the LAMBDA probe fine ?
Did you use our LEC 1.5m, 3.0m or 5.0m extension cable?
You have checked the correct wiring and they are not too long?
The maximum extension cable length is 5 m.

3) Do you have the LAMBDA probe installed in the correct position?
It should be installed at an angle upside down so that water and moisture can flow out of it. Please look at the picture from the previous page

4) Didn't you cut the connector on the LAMBDA probe?
The connector at the LAMBDA probe that contains the calibration resistor.
After cutting, 6th wire will be missing and LAMBDA measurement will show incorrect values.

5) Do you have a strong power supply with + 12V or 24V supply voltage?
The consumption of the lambda probe is 10W, so the source with a reserve should be at least 20W.
The level of supply voltage is displayed in the LAMBDA control application.

6) Did you configure the LAMBDA controller?
It is necessary to set the controller and write it in the memory for the required function eg curve type O2 4.0 and output 4-20mA.

· ### *How to protect LAMBDA signal against interference?*

We recommend the use of Twisted pair wires for connecting the LAMBDA probe to the Controller, for power supply and output signal or CAN-BUS.
It is necessary to count 10W for the power supply conductor, therefore the conductors should have a cross-section of at least about 0.75 to 1.5 mm2 with respect to the distance.

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- **How to set stepper motor mixture control ?**

   The setting is individual, but the main key is to know and set the number of steps for full opening and to start the engine.
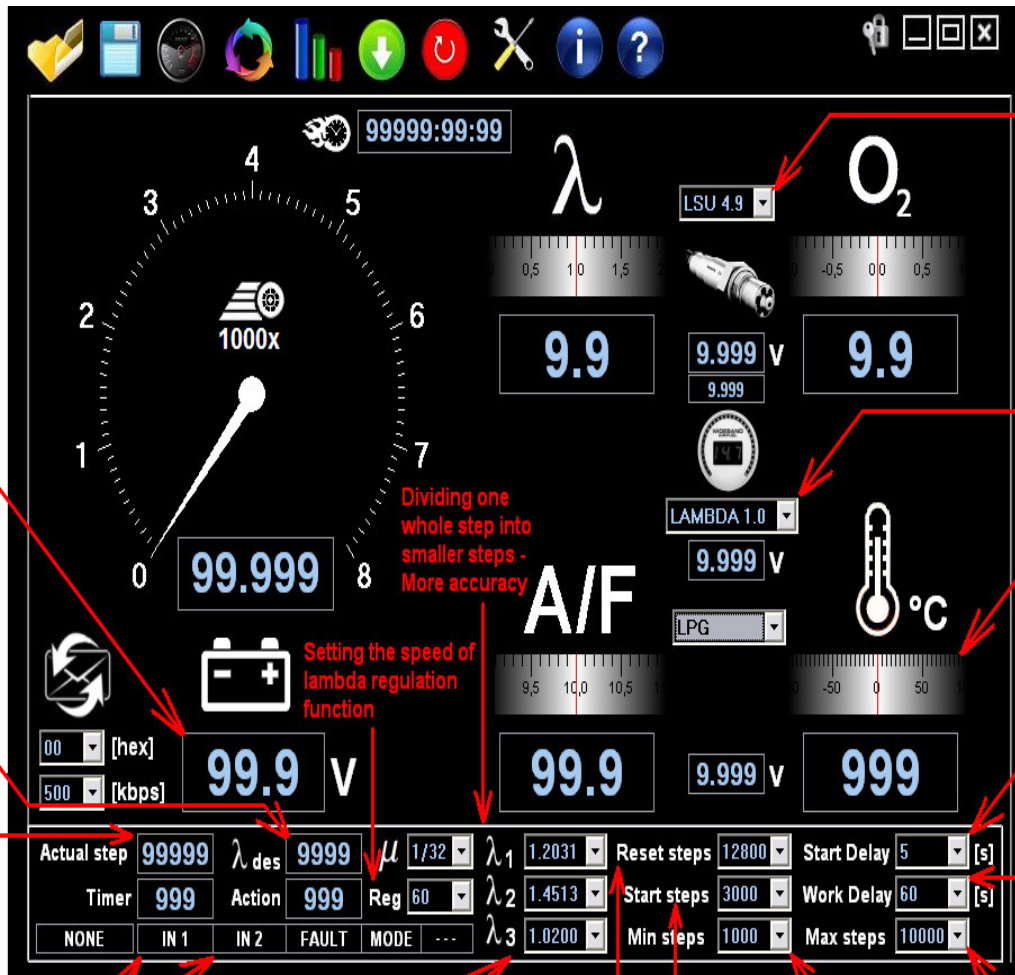
LAMBDA probe type 4.9 / 4.2

AO - Analog Output [0-5V,0-10V,0-20mA,4-20mA]

LAMBDA probe temperature

After Power On is a countdown timing Start Delay and then Stepper moves to the Start Step position. It can be used to clear the engine from excess gas before start.

Supply voltage

Dividing one whole step into smaller steps - More accuracy

Setting the speed of lambda regulation function

Desired LAMBDA value

Actual step position of the fuel mixer

Time to warm up the LAMBDA probe and switch on from start position to the regulation of mixture

Input signal DI1/ DI2

LAMBDA desired value Switch over signals

IN1 = L, IN2 = L → λ_1
IN1 = H, IN2 = L → λ_2
IN1 = L, IN2 = H → λ_3

It is necessary to find zero position after Power On. Number of Reset steps is used to full close and find the Reset position. May be equal to Max steps but usually need more.

The starting steps determine the optimal position for a starting the engine untiol the LAMBDA probe has warmed up. It is an ideal to use the steps required by the engine at idle speed.

The minimum value of the Steps which engine need for a running. Usually is used a value Greater then Zero but Less then Start Steps.

The maximum value of the steps to be used for mixture regulation. For example, the mixer can work with up to 30 000, but for maximum power you need only 10 000. Therefore you set up maximum 10 000 steps.

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