

ALM-Inline

Accurate Lambda Meter

V1.1.2

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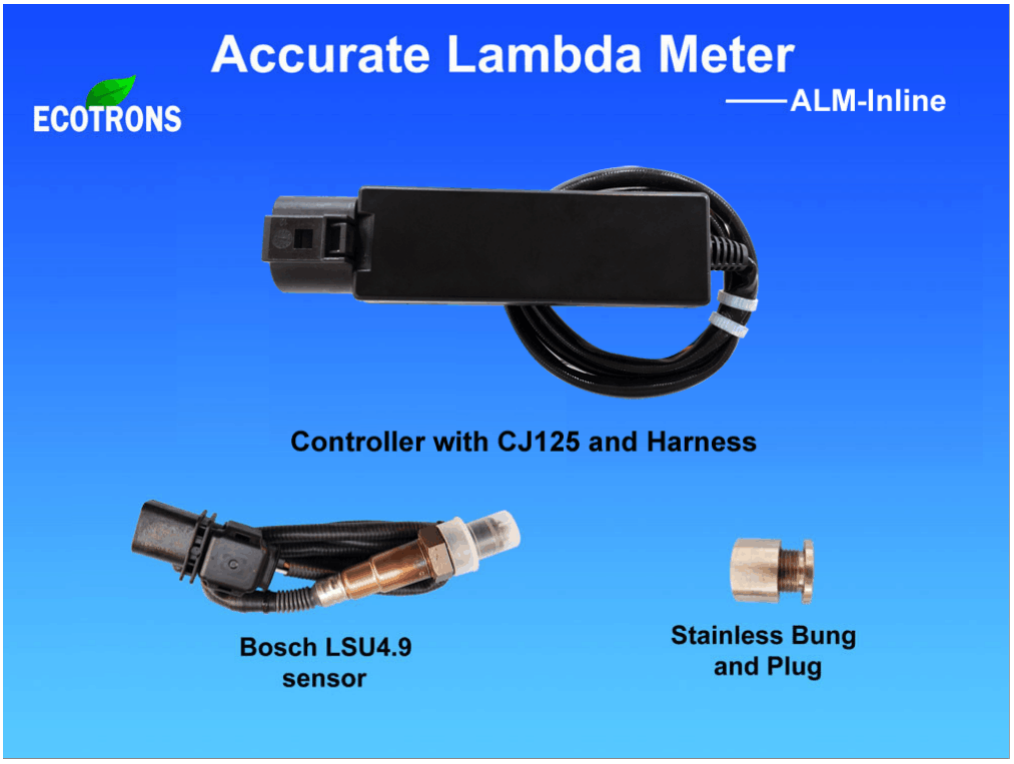
Http://www.ecotrons.com

Note: If you are not sure about any specific details, please contact us at info@ecotrons.com.

Check before you power on ALM-Inline:

- The oxygen sensor is installed in the right way; 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-Inline is correctly connected to DC 12V power supply or 12V battery.

ALM-Inline included parts:



List of ALM-Inline parts

- Small ALM Inline: 3.64" x 1.18" x 0.87"
- Bosch LSU 4.9 sensor
- Stainless plug and bung

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Chapter 1 ALM Product Overview

ALM (Accurate Lambda Meter) is a high-precision air-fuel-ratio (AFR) meter that detects the air-fuel ratio of the exhaust gas by measuring the oxygen concentration in the engine exhaust. ALM-Inline is one kind of our ALM products. ALM-Inline has a solid black plastic shell. It is more effective in preventing the circuit board from being damaged the volume is small. It eliminates the sensor wire. the sensor connector is fixed to the plastic shell and the appearance is more beautiful. it is more convenient to use.

ALM-Inline uses the Bosch CJ125 chip, which can accurately measure the oxygen concentration that can be converted to λ, AFR or other parameters required by the user. ALM-Inline uses a more advanced LSU4.9 oxygen sensor, rather than the LSU4.2 used by most other air-fuel ratio analyzers, and ALM-Inline uses a closed-loop module to control the temperature of the oxygen sensor to keep the LSU4.9 wide-area oxygen sensor temperature accurately At 780°C. LSU4.9 is a new wide-area oxygen sensor developed from LSU 4.2, which is superior to LSU 4.2, and Bosch has used LSU4.9 wide-area oxygen sensors for its automotive inspection equipment.

Bosch chip CJ125 is the integrated chip (IC) specifically designed for LSU 4.9 Sensors. Bosch's own wideband controller, "Lambda Tronic", uses CJ125 driver chip. In fact, Bosch uses this chip wherever a LSU sensor is used. The CJ125 and LSU sensor are mated-pair by Bosch. Presumably LSU sensors work the best with CJ125 chips.

See here for Bosch Motorsport's wideband controller, LT4:
http://www.bosch-motorsport.de/en/de/produkte/catalog_products_1_760313.php
The link may be updated by Bosch, please use the link on our website.

ALM uses the LSU 4.9 wideband sensor by default, and it can also use LSU ADV wide-area oxygen sensor, but need to update the software, if the customer wants to use LSU ADV sensor, please explain in advance

Products	Communication	Display	O2 Sensor Channels supported	ANOUT(Range）	O2 Sensor Supported	Exhaust temperature sensor	Exhaust pressure sensor	Engine Speed Input	Virtual narrow band o2 sensor output(NBOUT)
ALM-Gauge	RS232	AFR Gauge	1	YES（0 ~ 5v）	LSU 4.9(default)/ADV	NO	NO	YES	YES
ALM-Inline-ANOUT	**SCI(0 ~ 5v)**	**NO**	**1**	**YES（0 ~ 5v）**	**LSU 4.9(default)/ADV**	**NO**	**NO**	**NO**	**NO**
ALM-B-ANOUT	SCI(0 ~ 5v)	NO	1	YES（0 ~ 5v）	LSU 4.9(default)/ADV	NO	NO	NO	NO
ALM-B-CAN	CAN	NO	1	NO	LSU 4.9(default)/ADV	NO	NO	NO	NO
ALM-B-RS485	RS485	NO	1	NO	LSU 4.9(default)/ADV	NO	NO	NO	NO
ALM-LED	RS232	LED （4 bit）	1	YES（0 - 5v）	LSU 4.9(default)/ADV	NO	NO	YES	YES
ALM-CAN	CAN	NO	1	NO	LSU 4.9(default)/ADV	NO	NO	NO	NO
ALM-CAN-II	CAN	NO	2	NO	LSU 4.9(default)/ADV	NO	NO	NO	NO
ALM-II	RS232	LCD(128*64)	2	YES（0 - 5v）	LSU 4.9(default)/ADV	NO	NO	YES	YES
ALM-LD	RS232/CAN/USB	LCD(640*480)	2	YES（0 - 10v）	LSU 4.9(default)/ADV	YES	YES	YES	YES

Note: Blue font represents the current user manual supported of ALM units.

Chapter 2 ALM-Inline technical specifications

Power supply

- Input voltage range: DC 12V for the Inline, 12V for the O2 sensor
- Input current: 60mA typical for the Inline; the heater current directly from 12V supply

Sensors

- Standard configuration: LSU 4.9 (Support LSUADV; LSU 4.2 capable but not recommended)
- Number of Sensors: One
- Free air calibration: No need

Accuracy

- Range of measurement: λ = 0.5 ~ ∞
- Measurement accuracy: ±0.008 @ λ=1.00
±0.01 @ λ=0.80
±0.05 @ λ=1.70
- Air/Fuel Ratio: Fuel dependent (see lambda range and accuracy)
- Range of O2%: -21% ~ 21%

Response time

- 5ms updating rate
- 0-5v analog output in 5ms updating rate;

Heater

- Control: Built-in PID control with CJ125
- Current: Typical 1A;Peak 3.5A
- Heater return (H-): Separate wire from Ground

Output

- Lambda analog output: 0 ~ 5V analog the user can set
- Analog accuracy: ±0.005V error with a 10-bit DAC chip

Communications

- SCI communications(option)

Main-Processor

- CPU: Freescale MC9S12P128 16-bit micro-processor (Automotive level)
- Speed: 32MHz
- Memory: 128k Flash, 6k RAM, 4k Data

Special features

- On-Inline-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: -40°C ~ 85°C
- Dimensions: 3.64" x 1.18" x 0.87"

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Chapter 3 Appearance and dimension

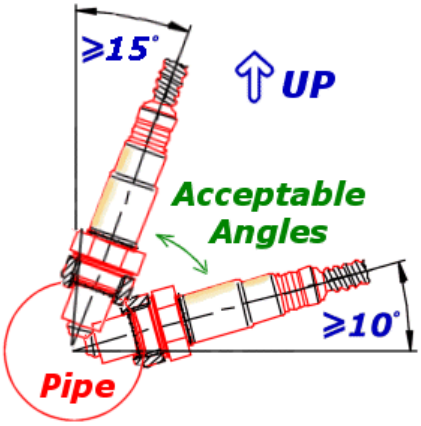
3.1 Box size



Chapter 4 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 10º~75º from the horizontal line (see below figure). The typical tilt-angle is 30º. 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 18mm 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 narrow band oxygen sensor (LSF) on your vehicle, you can just un-plug the LSF, and plug-in the wideband LSU sensor into the same hole. Bosch LSU and LSF have the same size of the thread.

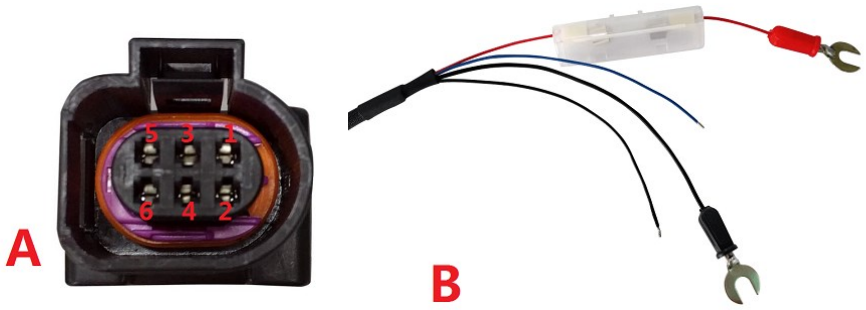
More User Notes

- ⚠ 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-Inline, 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 500~900ºC, the best temperature is 780ºC. Too high temperature (>1030ºC) will cause damage of the sensor. Refer to Bosch LSU 4.9 data sheet for more details about the variant temperature requirements.
  http://www.etas.com/en/downloadcenter/5858.php
- ⚠ 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-Inline, which will ramp up the heating power smoothly.

Chapter 5 ALM-Inline operating instructions

5.1 ALM-Inline with 0-5v analog output

The aftermarket version of ALM-Inline comes with a 0-5v analog output (ANOUT) for the main controller to read. 0-5v analog output is linear to the Lambda、O_2% or AFR that ALM measures from the exhaust gas.



Connector	Pin#	Name	Description	Min	Max
A	1	RH	wideband oxygen sensor input	—	—
	2	UN		—	—
	3	IA		—	—
	4	IP		—	—
	5	VM		—	—
	6	VS		—	—
B	Red wire	+12V	+12V Power supply	—	—
	Black thick wire	GND-H	Ground (Heater circuit ground)	0V	0V
	Black thin wire	GND-R	Ground (Reference ground)	0V	0V
	Blue wire	ANOUT	Lambda linear analog output	0V	5V

5.1.1 Connect ALM-Inline to the main board with ANOUT

This analog output from ALM-Inline is linear to the actual Lambda/AFR/O2% measured. By setting the lower point and upper points of voltage vs Lambda/AFR/O2% linear relation, the scaling between the voltage and Lambda/AFR/O2% is determined.

The default setting is

0V~ Lambda 0.50

5V~ Lambda 2.00

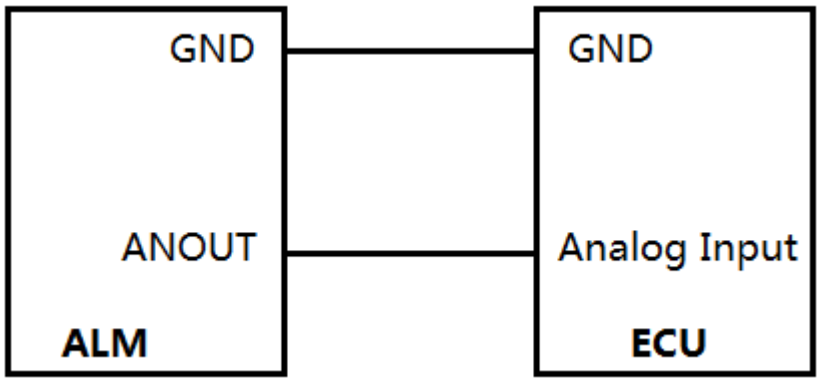
Lambda = Volt * (2.00-0.50)/ (5-0) + 0.50, which is: Lambda = Volt * 0.30 + 0.50;
Volt ~ ANOUT voltage.

User can change this setting by using ALM GUI. The max setting is:

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0 Volt at Lambda 0.50;

5 Volt at Lambda 16.0



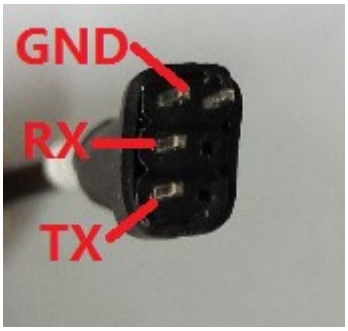
5.2 How to use the communication function of ALM-Inline

ALM-Inline with SCI port outputs a TTL level signal, voltage range is 0V to 5V. It needs a conversion circuit to convert TTL level to RS232 level, if users want ALM-Inline to connect to computer. If the computer does not have a serial port, users also need an RS232-USB module to convert the 232 level to USB level. Ecotrons can offer you MAX232 adapter and RS232-USB module, but they are optional.
The following figure is a picture of these modules









Wiring method:

1. Open the ALM-Inline box and plug the pin of “Commuication adapter” into the ALM-Inline pin (There is a description of pin on the board).
2. Connect “the Commuication adapter” to the “MAX232 adapter”, then connect the “MAX232 adapter” to the “RS232-USB Converter”, and plug the RS232-USB Converter into the USB port on your computer.

Note: If the computer has a serial port, users can choose not to use RS232-USB module, MAX232 adapter can be directly connected with the computer serial port.

5.3 SCI Communication protocol

The software protocols used for SCI and RS232 bus are same. The only difference is the voltage levels. SCI is at 5v TTL, while RS232 is at +/- 12V.

SCI communication is based on automotive standard KWP2000 protocol, default baud rate is 115200, no parity bit, 8 data bits, 1 stop bit.

Send the ‘Get Data Request’ command to ALM, you will receive data from ALM in 20ms rate.

More details, please refer to the chapter 1.2.2 of ALM Communication Protocol - SCI You can download the ALM Communication Protocol from the link.

http://www.ecotrons.com/support/.

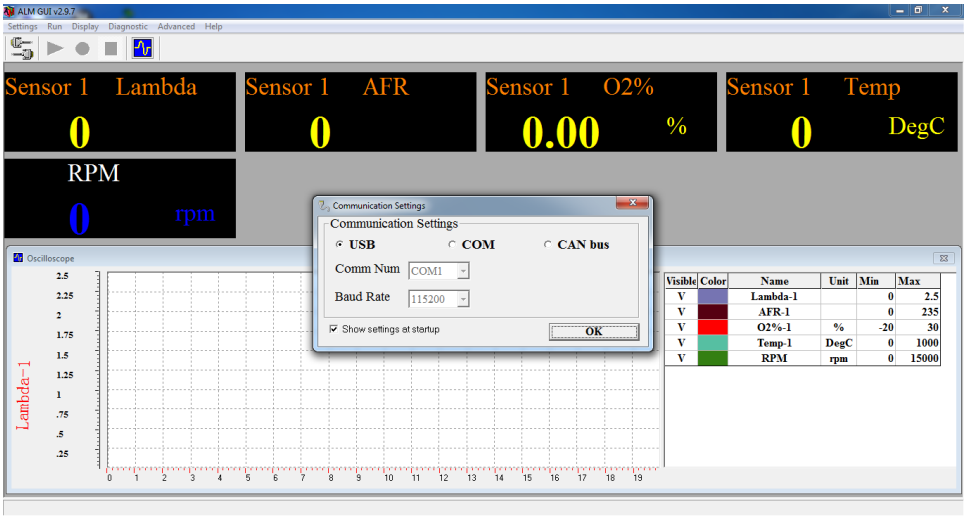
Command	Direction			Data(Hex)	Data(Physical)
Get Data Request	Host → ALM	Header	Fmt	0x80	
			Tgc	0x8F	
			Scr	0xEA	
			Len	0x03	
		Data	Data 1	0x9C	
			Data 2	0x0D	
			Data 3	0x00	
		Checksum	Checksum	0XA5	
Get Data Response	ALM → Host	Header	Fmt	0x80	
			Tgc	0x8F	
			Scr	0xEA	
			Len	0x22	
		Data	Sid	0xE5	
			Command	0x0D	
			Data3	Sensor 1 Lambda High 8 bits	Lambda 1 = (Data3 * 256 + Data4) / 1000
			Data4	Sensor 1 Lambda Low 8 bits	
			Data5	Sensor 2 Lambda High 8 bits	Lambda 2 = (Data5 * 256 + Data6) / 1000
			Data6	Sensor 2 Lambda Low 8 bits	
			Data7	Rpm High 8 bits(optional)	Rpm = (Data7 * 256 + Data8) * 40 (optional)
			Data8	Rpm Low 8 bits(optional)	
			Data9	Vin 1 High 8 bits(optional)	Vin 1 = (Data9 * 256 + Data10) * 5 / 1024 (optional)
			Data10	Vin 1 Low 8 bits(optional)	
			Data11	Vin 2 High 8 bits(optional)	Vin 2 = (Data11 * 256 + Data12) * 5 / 1024 (optional)
			Data12	Vin 2 Low 8 bits(optional)	
			Data13	Sensor 1 Temp High 8 bits	Sensor 1 Temp = (Data13 * 256 + Data14) * 0.023438-273 (DegC)
			Data14	Sensor 1 Temp Low 8 bits	
			Data15	Sensor 2 Temp High 8 bits	Sensor 2 Temp = (Data15 * 256 + Data16) * 0.023438-273 (DegC)
			Data16	Sensor 2 Temp Low 8 bits	
			Data17	Sensor 1 O2% High 8 bits	Sensor 1 O2% = (Data17 * 256 + Data18) / 1024
			Data18	Sensor 1 O2% Low 8 bits	
			Data19	Sensor 2 O2% High 8 bits	Sensor 2 O2% = (Data19 * 256 + Data20) / 1024
			Data20	Sensor 2 O2% Low 8 bits	
			……	Reserved	
		Data	Data34		
		Checksum	Checksum	Checksum byte	

5.4 How to Configure 0-5v Analog Output

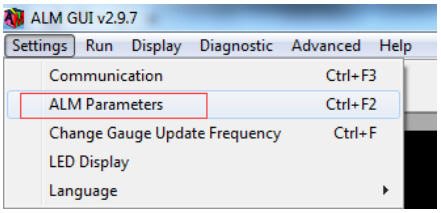
You can use computer software, ALM GUI to change the linear relation of ANOUT and lambda.

1) ALM-Inline connects to the computer via Commuication adapter, MAX232 adapter and RS232-USB module (it cannot be connected directly to the computer, and interface module is required for level conversion, see section: 5.2)

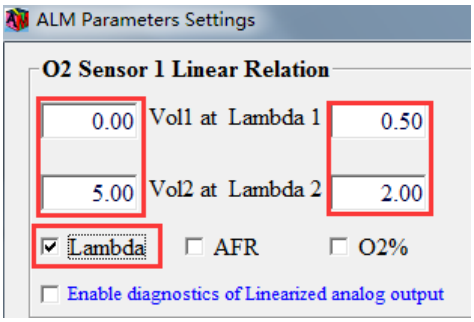
2) Run ALM GUI, and connect to ALM-Inline;

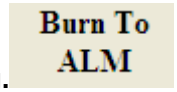


3) Click Settings→ALM Parameters, open ALM Parameters window to set the ALM analog output range, gauge range, and fuel type, etc.



4) For example, set 0V—lambda 0.5 5V—Lambda 2



Click 'Burn To ALM' after changing the setting. 

More details please refer to the chapter 2.4.1 of ALM GUI Manual.
http://www.ecotrons.com/support/.

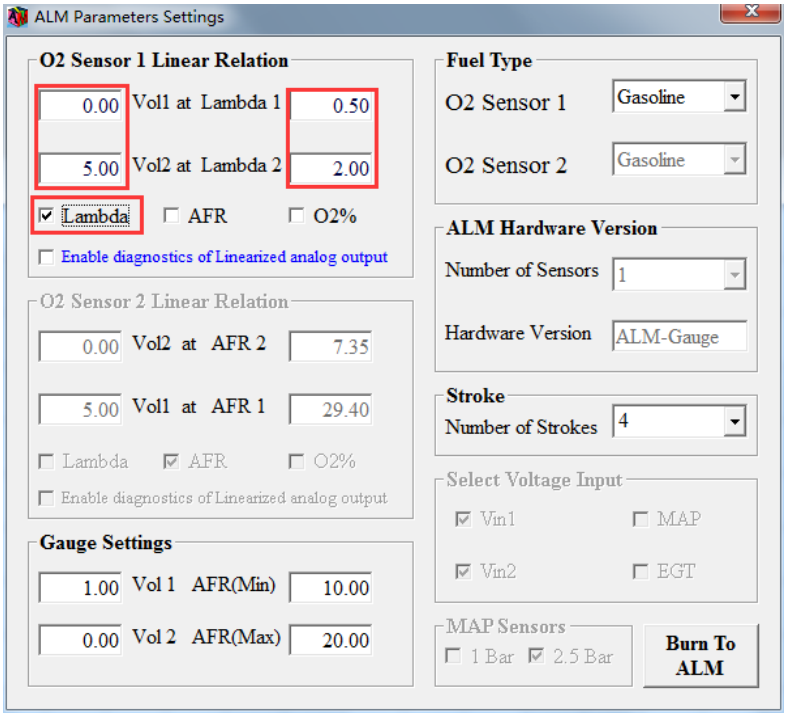
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5.4.1 ANOUT Calibration

Lambda mode, ANOUT used to indicate changes in lambda, the default setting:

0.00 Volt at Lambda 0.50

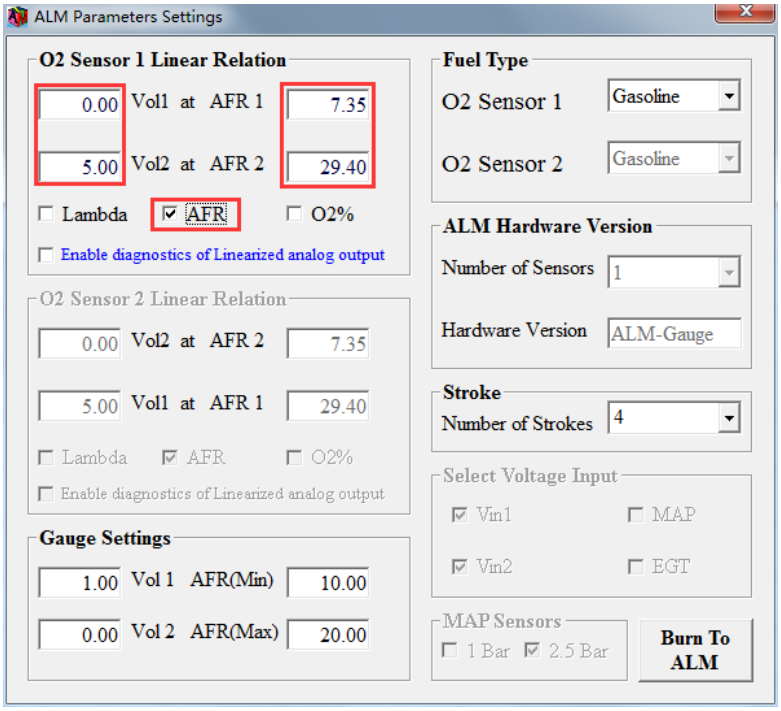
5.00 Volt at Lambda 2.00



AFR mode, ANOUT used to indicate changes in AFR, the default setting:

0.00 Volt at AFR 7.35

5.00 Volt at AFR 29.4

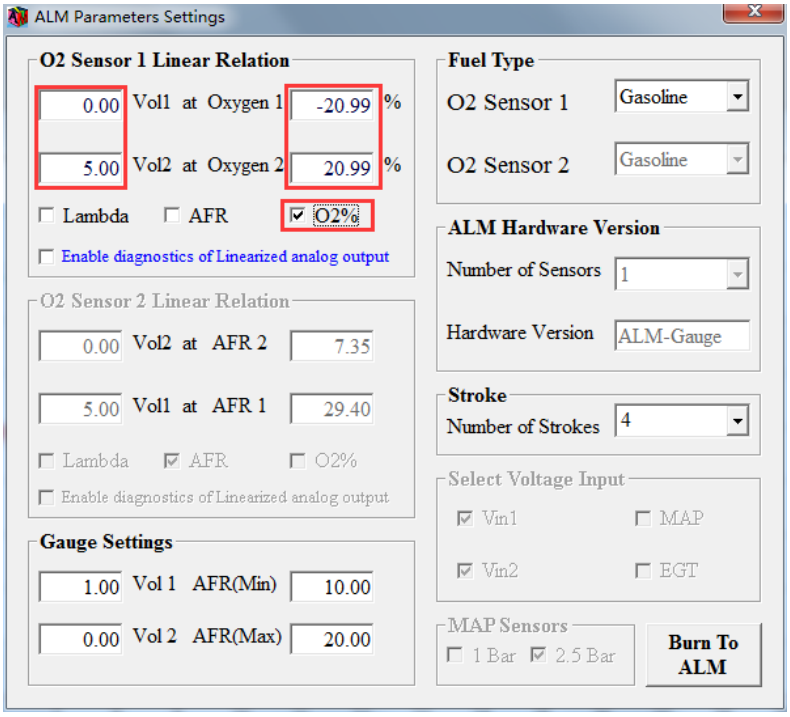


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O2% mode, ANOUT used to indicate changes in O2%, the default setting:

0.00 Volt at O2% -20.99

5.00 Volt at O2% 20.99



If customers want to modify these parameters, user can refer to the chapter 2.4 of ALM GUI Manual..

http://www.ecotrons.com/support/

Note：The limit range of analog voltage is 0-5v. The value of lambda is 0.5-16. The low voltage must match the low Lambda. You can't make 5V match 0.5 Lambda. AFR and O2% are same with Lambda.

Chapter 6 DTC table

Below is the Diagnostic Trouble Code table. ALM-Inline has on-Inline-diagnostics capability to detect most common errors. The first thing user should do when ALM-Inline 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 2. Change the LSU
E4	LSU yellow wire (VM) short to GND	1. Check the harness for short-to-ground 2. Change the LSU
E5	LSU black wire (UN) short to power	1. Check the harness for short-to-power 2. Change the LSU
E6	LSU black wire (UN) short to GND	1. Check the harness for short-to-ground 2. Change the LSU
E7	LSU green wire (IA) short to power	1. Check the harness for short-to-power 2. Change the LSU
E8	LSU green wire (IA) short to GND	1. Check the harness for short-to-ground 2. Change the LSU
E9	Operating voltage too low	Check the power supply to the ALM spec.
E10	Heater circuit damaged	Check the LSU connector
E11	Heater circuit short to power	Contact the manufacturer
E12	Heater circuit short to GND	1. Check the harness for short-to-ground 2. change LSU 3. Contact the manufacturer