ALM Board RS485

ALM-BR4-4.3

Accurate Lambda Meter (ALM-BR4-4.3)

– Mini Board Version

V1.0

www.ecotrons.com

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

Check before you power on ALM-Board:

- The oxygen sensor is installed in the right way or it's left in the free air. Make sure the environment is dry and it's not close to the inflammable materials.
- The ALM-Board is correctly connected to DC power supply 12V battery.
- GND-H and GND-R need to be connected with the negative pole of power supply, so that ALM board can work properly.

Content

Chapter 1 **ALM Product Overview**

ALM (Accurate Lambda Meter) is an air-fuel-ratio (AFR) meter that uses the Bosch LSU 4.9 wideband oxygen sensor and Bosch semiconductor chip CJ125 to accurately measure the AFR or lambda for variant combustion engines.

ALM-Board is a version of ALM that trims off the peripheral parts and keeps the minimum set of electronics yet providing the core function of the wideband controller. It is a mini-size board, 70.5mm*32mm*28mm, and it can be plugged into the main controller board easily. The only thing that it needs from the mainboard is 12V power supply. ALM-Board has the full control function for LSU 4.9 sensor. Same as our other ALMs, it has a CJ125 chip built-in. It measures the O2 concentration accurately, and converts it to either lambda or AFR, as you want. It controls the sensor temperature in a close loop mode, accurately around 780^{o}C degrees. ALM-Board communicates using RS485.

ALM-Board is designed to fit into the OEM's controller case with a very small footprint. It has its own LSU 4.9/ADV sensor connector and cable. It can be connected to the mainboard via a mini connector. Or you can request a customized connection between the ALM-Board and your mainboard. We do customization for small manufacturers.

All our ALMs have high accuracy and fast response characteristics, which are the root of our design at the very beginning.

First, ALM uses the LSU 4.9 wideband sensor. And it can also use the LSU ADV sensor by changing the configuration in the ALM GUI software.

Second, Bosch CJ125 chip is the integrated chip (IC) specifically designed for LSU 4.9 sensors. Bosch's own wideband controller, "Lambda Tronic", uses the CJ125 driver chip. Essentially, Bosch uses this chip wherever an LSU sensor is used. The CJ125 and LSU sensors 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 market.

Chapter 2 ALM-Board Technical Specifications

Power supply

- Input voltage range: DC12V (typical value), DC 10V ~15V
- Input current: 60mA typical for the board; the heater current directly from 12V supply

Sensors

- Standard configuration: LSU 4.9
- Also support: LSU ADV (software configuration needed)
- Number of Sensors: One
- Free air calibration: No need

Accuracy

- Range of measurement: λ = 0.65 ~ ∞
- 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 O_2%: -21% ~ 21%

Heater

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

Output

- Analog accuracy: ±0.005V error with a 10-bit DAC chip

Communications

- RS485 customer protocol

Main Processor

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

Special features

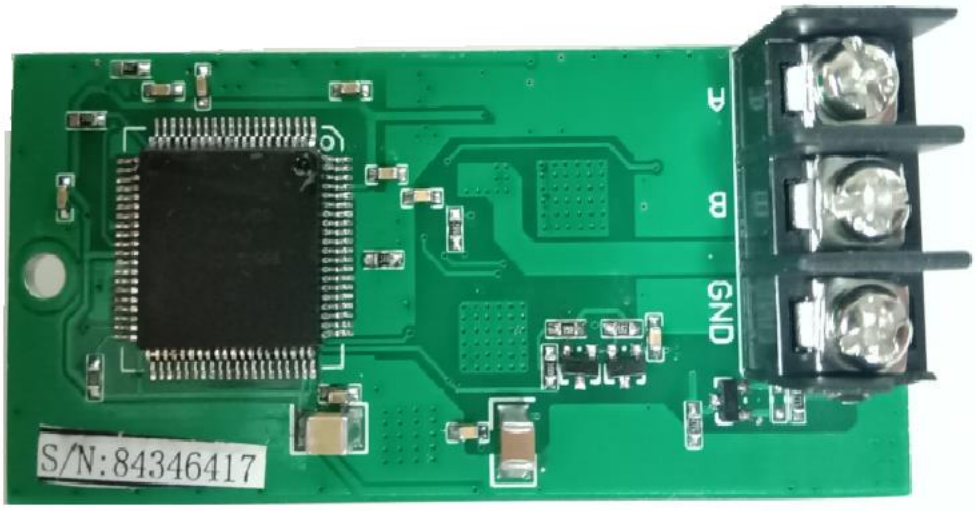
- On-Board-Diagnosis and error report
- Self-learning of part-to-part variations, aging effect
- Working with different types of fuels (gasoline, diesel, E85, etc)

General

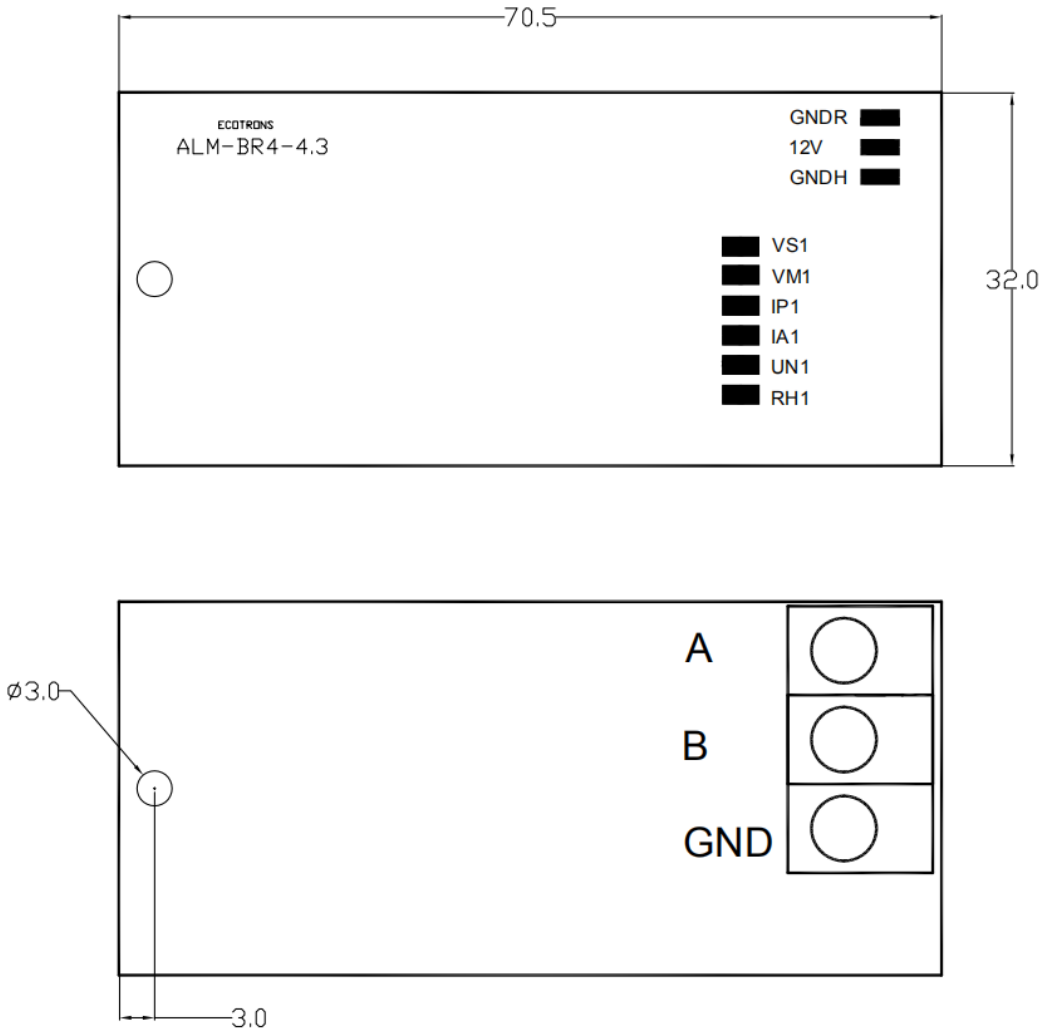
- Temperature range: -40°C ~ 85°C
- Dimensions: 70.5mm*32mm*28mm

Chapter 3 **Appearance and Dimension**

3.1 Appearance picture



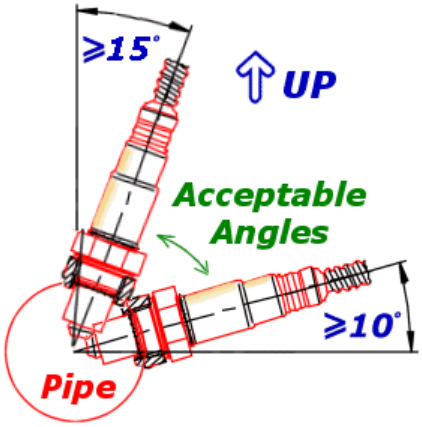
3.2 Dimensions (Unit: mm)



Chapter 4 **Oxygen Sensor Protection**

Installation

The correct installation of the oxygen sensor is a must to avoid sensor damage. It protects the oxygen sensor from condensations and gives the sensor a longer life. It can also 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°~75° from the horizontal line (see below figure). The typical tilt-angle is 30°. 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.

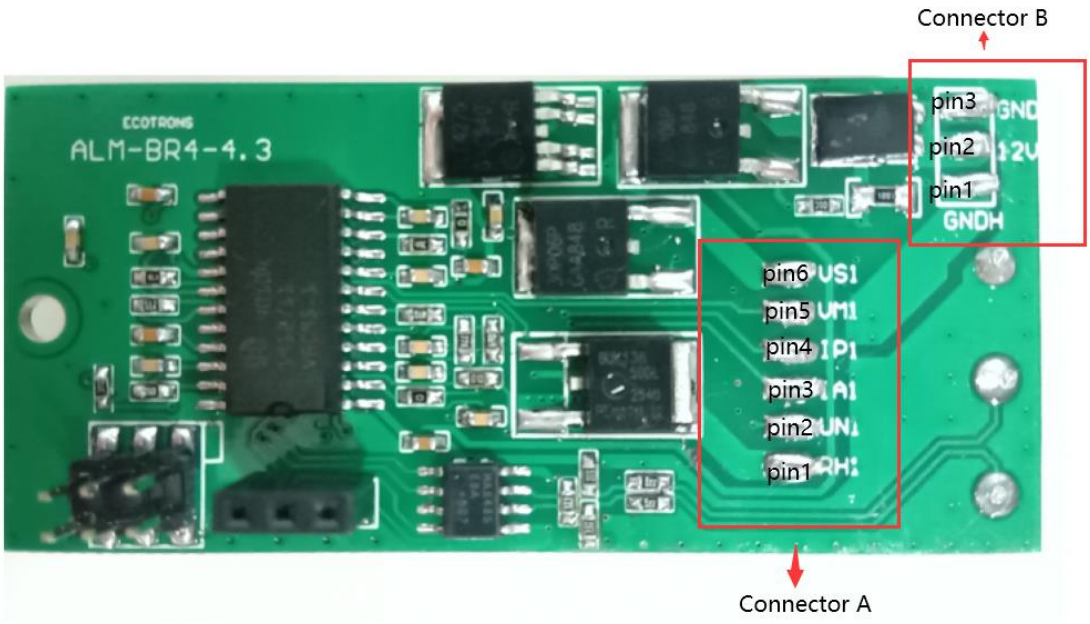
Note, if your vehicle has a Bosch narrowband oxygen sensor (LSF) on your vehicle, you can just un-plug the LSF, and plug-in the wideband LSU sensor into the same hole. Bosch LSU and LSF have the same size of the thread.

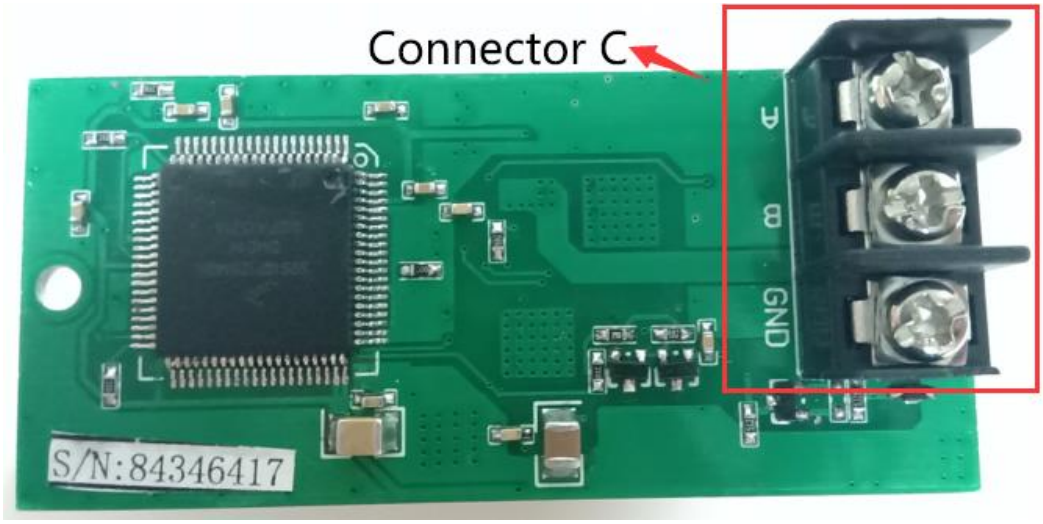
More User Notes

- ⚠ 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-Board, which controls the LSU heater. Otherwise, a long-time-running engine with LSU sensor not heated can cause damage to the sensor.
- ⚠ LSU sensor is preferred to run within the temperature range of 500~900°C, the best temperature is 780°C. Too high temperature (>1030°C) will cause damage to the sensor.
- ⚠ 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 to the sensor if the sensor is heated. The preferred order: start the engine first, then immediately turn on the ALM-Board, which will ramp up the heating power smoothly.

Chapter 5 **ALM-Board Operating Instructions**

5.1 Pin Assignment





Connector	Pin #	Name	Description	Min	Max
Connector A	1	RH	Wideband oxygen sensor input	—	—
	2	UN		—	—
	3	IA		—	—
	4	IP		—	—
	5	VM		—	—
	6	VS		—	—
Connector B	1	GND-H	Ground (Heater circuit ground)	0V	0V
	2	+12V	+12V Power supply	9V	15V
	3	GND-R	Ground (Reference ground)	0V	0V
Connector C		A	RS-485 Communication		
		B	RS-485 Communication		
		GND	Ground (Reference ground)	0V	0V

5.2 Communication Protocol for RS485 Bus

RS485 communication is based on Modbus protocol. Ecotrons Modbus protocol uses ASCII and RTU mode and supports PLC, DTC, etc.

More details refer to ALM Communication Protocol – SCI.doc

http://www.ecotrons.com/download/

RTU mode:

Upload O_2%, Lambda, and LSU Temperature

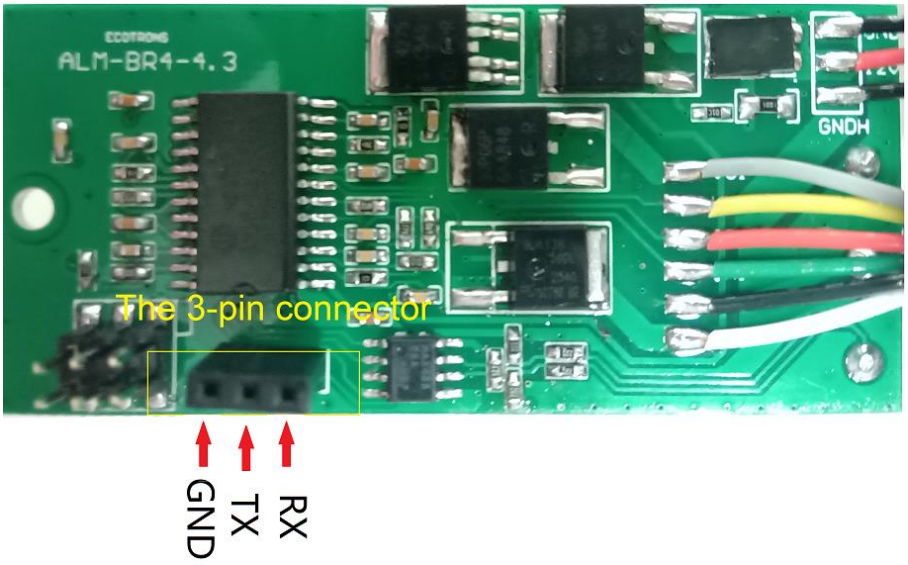
PLC →ALM, PLC sends: "50 03 2000 0004 42 48"

ALM →PLC, PLC receives: "50 03 08 xxxx xxxx xxxx xxxx xxxx"

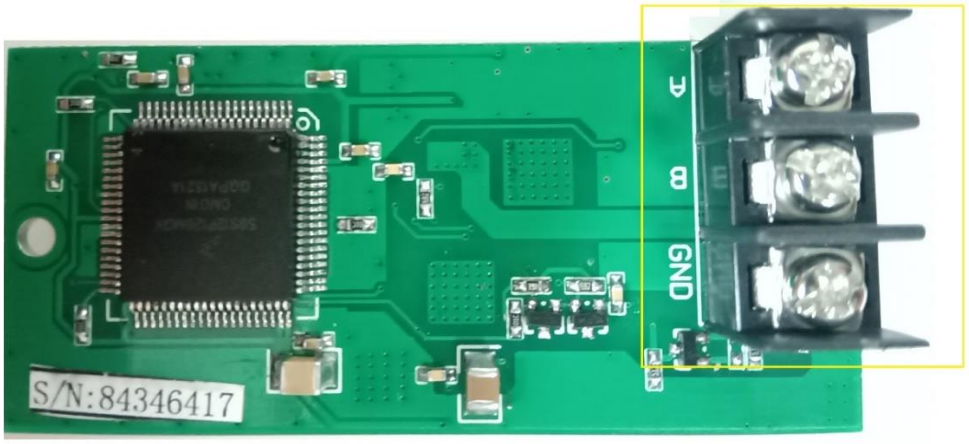
#		PLC to ALM, PLC sends: "50 03 2000 0004 42 48" ALM to PLC, PLC receives: "50 03 08 xxxx xxxx xxxx xxxx xxxx"			Resolution	Units	Range
1	Upload O2%, Lambda, and LSU Temperature	Registers for sent data (sending messages)	PLC to ALM Request Description	Data(byte)			
			ADR	50			
			CMD	03			
			Start Addr Hi	20			
			Start Addr Lo	00			
			No. Bytes Hi	00			
			No. Bytes Lo	04			
			CRC CHK Lo	42			
			CRC CHK Hi	48			
2		Registers for received data (responding messages)	ALM to PLC Response Description	Data(byte)			
			ADR	50			
			CMD	03			
			No. Data	08			
			O_2% High 8-bit	xx	O2% =((O_2% High 8-bit) *256 + (O2% Low 8-bit)) * 0.000514 – 12	%	-21% to 21%
			O_2% Low 8-bit	xx			
			Lambda High 8-bit	xx	Lambda = ((Lambda High 8-bit) *256+(Lambda Low 8-bit)) *		0.5 to 16
			Lambda Low 8-bit	xx			

					0.000244		
			LSU Temperature High 8-bit	xx	LSU Temperature = ((LSU Temperature High 8-bit)*256 + (LSU Temperature High 8-bit)) * 0.023438	Deg K	840 to 1303
			LSU Temperature Low 8-bit	xx			
			LSU Faults High 8-bit	xx	LSU Sensor faults = ((LSU Faults High 8-bit) *256+(LSU Faults Low 8-bit))		0 to 12
			LSU Faults Low 8-bit	xx			
			CRC CHK Lo	xx			
			CRC CHK Hi	xx			

Chapter 6 How to Communicate to ALM GUI



The 3-pin connector in the picture above is only used for flashing the S19 file. And that is RS232 bus.



The ModBUS or RS485 communication must be through the regular port “A” and “B” showed in second picture above.

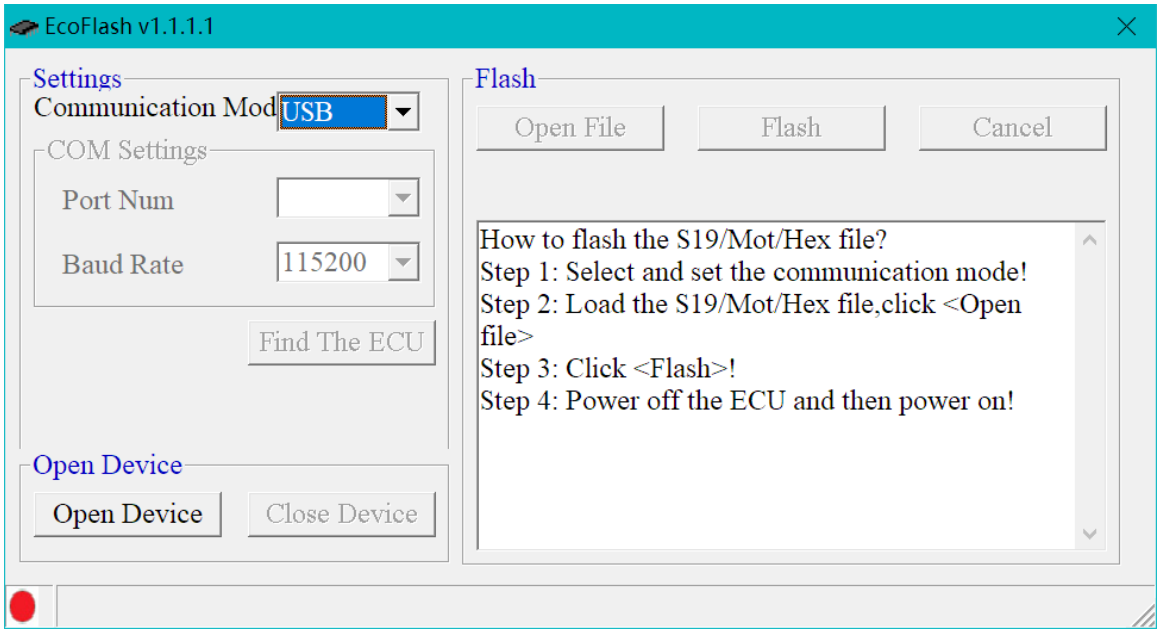
These two are different communication interfaces. The correct process is:

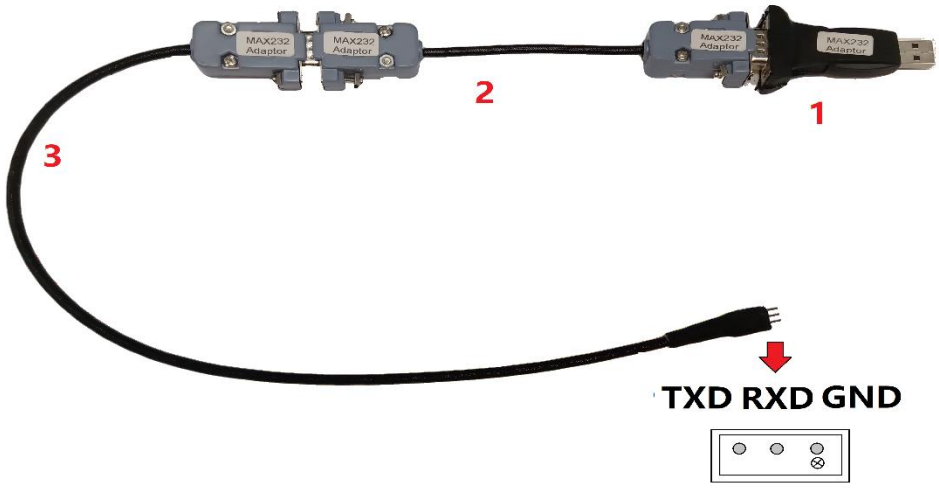
1) Flash the S19 file via the 3-pin connector on the board using EcoFlash software.

2) Connect the ALM-GUI-RS485 software tool to Port “A” and “B”, via RS485-USB converter.

We have not combined the 2 communication interfaces in one software because the flashing process requires the bootloader to be activated, which is not compatible with RS485 / ModBUS.

6.1 How to Flash the S19 File





In the above picture, part 1 is connected to the computer;

In the above picture, part 2 is connected to the 3-pin connector of the ALM board.

Note: The MAX 232 adapter and USB-RS232 converter are optional, and they are not included in the standard ALM-Board kits.

Users can connect the ALM-Board to the computer using the MAX232 adapter and USB-RS232 converter directly, as described above.

After connecting the power supply, you can start in **EcoFlash** as follows:

Step 1: In the settings, set the communication mode to USB

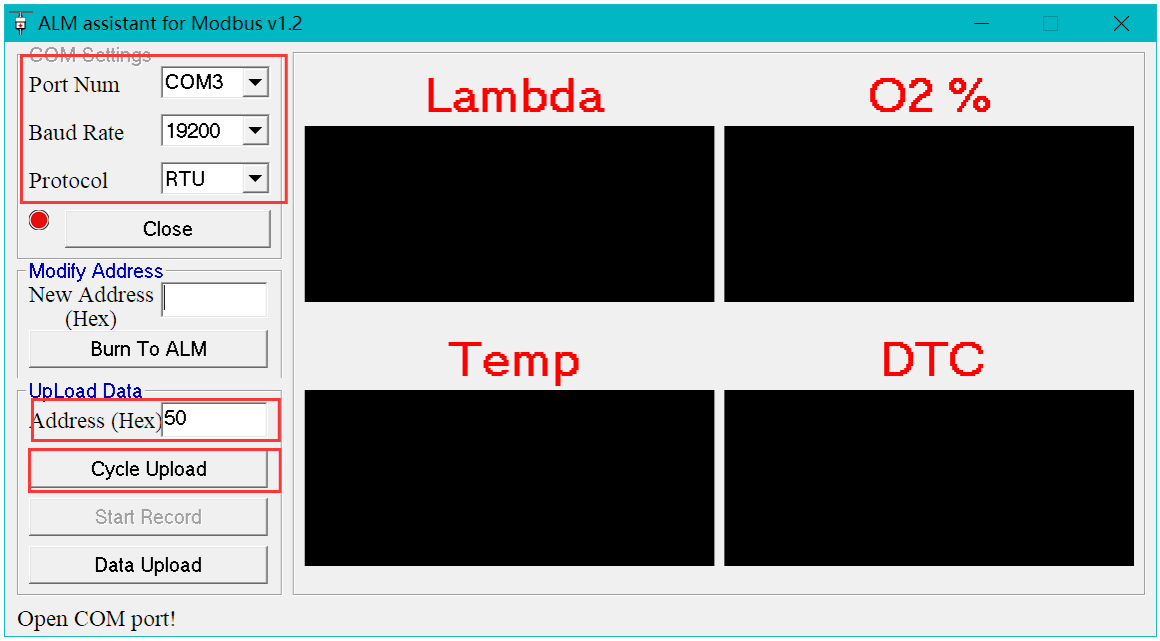
Step 2: Click <Open file> to select and load the S19 file

Step 3: Click <Flash>

Step 4: You will see the alert on the bottom of the window to power off the ECU and then power on. Please power off and power on as it says.

Note: When flashing S19, the connection between ALM borad and RS485 / ModBUS must be disconnected. Otherwise, S19 cannot be flashed.

6.2 ALM GUI for Modbus



Default Configuration	
Port Num	Please look it up in your computer
Baud Rate	19200
Protocol	RTU
New Address	Modify it when you need to
Address (Hex)	50

Step 1: Connect the power supply (DC12V). Note that both GND-H and GND-R need to be connected with the negative pole of the power supply

Step 2: Connect the ALM-GUI-RS485 software tool to Port “A” and “B”, via RS485-USB converter

Step 3: COM Settings according to the table above

Step 4: Click <Cycle Upload>

Chapter 7 **DTC Table**

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