

ALM-II Manual

Accurate Lambda Meter
_with Dual Channels

V2.3

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

Check before you power on ALM-II:

- 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-II is correctly connected to DC power supply or 12V battery;

ALM-II includes parts:





List of ALM parts

- ALM-II controller
- Harness (60in default, 120in optional)
- 2x Bosch LSU 4.9 sensor
- 2x Sensor plug and bung
- Serial communication cable
- USB to serial converter (optional, not included)
- CD - documents and ALM GUI software

Table of Content

Chapter 1 ALM-II Product Overview 6

Chapter 2 ALM-II technical specifications 8

Chapter 3 Appearance and dimension 10

Chapter 4 Protect your oxygen sensor 11

Chapter 5 ALM-II hardware connections 12

5.1 ALM-II main connector pin-out 12

5.2 Installation Procedures 13

5.3 ANOUT Calibration 16

Chapter 6 DTC table 18

Chapter 1 ALM-II Product Overview

ALM-II (Accurate Lambda Meter with Dual Channels) is the dual-channel version of ALM. It includes 2x LSU 4.9 sensors, driven by Bosch CJ125 chips. It is typically used for V-shape engines, like V6, V8 or V10 engines, etc. It has all features of ALM, and more. It replaces ALM LED display with a LCD and display more info: lambda or AFR, O2 concentrations in percentage (O2%), Analog inputs, etc.

All connectors are upgraded to the industry rated, and the housing is aluminum, and rugged.

Real time measurement of O2 concentrations in the exhaust gas has become the new standard for a wideband controller. Only a few wideband controllers can do that.

Again, ALM-II can measure a wider range of lambda, especially between 1.5 to 3.0 lambda ranges. That's the key area for diesel, gaseous fuel, flex fuel, dual fuel engines. Only a few wideband controllers can do that, again.

ALM-II uses the more advanced LSU 4.9 wideband sensor. And it can also use LSU ADV sensor, but users need to tell your specific needs when you place an order.

Bosch chip CJ125 is the integrated chip (IC) specifically designed for LSU 4.9 Sensors. Bosch's own wideband controller, "LambdaTronic", 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.

Besides air/fuel ratio measurement, ALM-II provides some supplemental functions which make your measurement or tuning more convenient: linear analog output to your ECU; LCD digital display; engine RPM probe, other sensor analog signal input like MAP and/or exhaust gas temperature (EGT); data logging with a serial communication to a PC, etc.

The accuracy and response time are the most important characteristics of the lambda meter, or any metering device to show the accuracy and the fast response of ALM, we compare the ALM analog output to the analog output of INNOVATE's LC-1 and LM2, which are claimed to be the leaders of the aftermarket wideband controllers.

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-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.

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Chapter 2 ALM-II technical specifications

Power supply

- Input voltage range — DC 9V~15 V (12V Typical)
- Input current — 100mA typical plus the heater current
- Polarity protection — Reverse polarity protected
- Load Dump Clamp — Maximum Voltage 33V

Sensors

- Compatible — LSU 4.9 (Support LSU ADV, LSU 4.2 capable but not recommended)
- Number of Sensors — Dual LSU sensors optional
- Free air calibration — Not necessary

Measurement

- Lambda range — λ = 0.5 ~ ∞
- Lambda 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)
- Oxygen concentration range — -21% ~ 21%

Heater

- Control — Built-in PID control with CJ125
- Current — Typical 2A; Peak 5A
- Heater return (H-) — Separate wire from Ground

Output

- Lambda analog output — 0~5V user programmable
- Analog accuracy — ±0.005V error with a 10-bit DAC chip
- Narrow band O2 sensor simulated output (user programmable)

Input

- RPM input — Injection pick-up
- Analog input — MAP sensor optional
- Analog input — EGT (exhaust gas temperature) sensor optional

Communications

- RS232 or USB (via a converter) for logging or programming
- User-friendly PC software for data acquisitions and analysis

Display

- Low cost LCD display
- LCD temperature range — Nominal operating temperature: -20°C ~ 70°C
storage temperature: -30°C ~ 80°C

Main-Processor

- CPU — Freescale MC9S12P128 16-bit micro-processor (Auto industry rated)
- Speed — 32MHz
- Memory — 128k Flash, 6k Ram, 4k Data

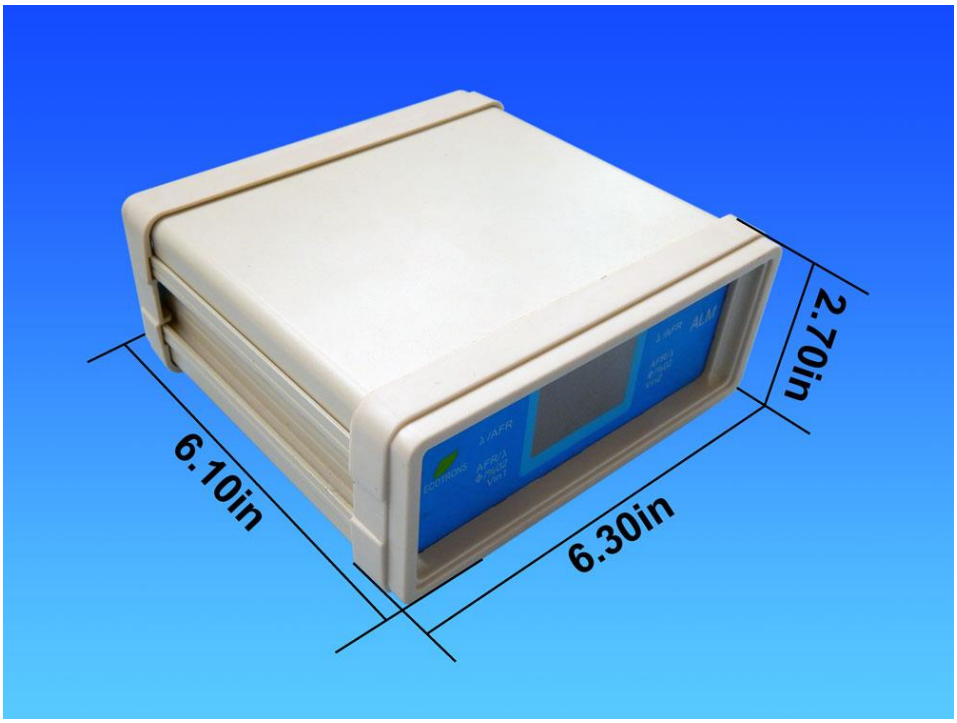
Special features

- 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 -20°C ~ 70°C
- Dimensions 6.10" x 6.30" x 2.70"

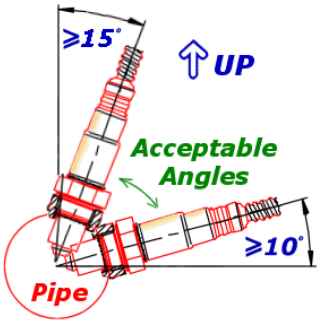
Chapter 3 Appearance and dimension



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 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 18 mm in diameter. Weld the sensor bung on it.

Note: do not weld the bung with the sensor in it.

Note, if you vehicle has a Bosch switching oxygen sensor (LSF) on your vehicle, you can just un-plug the LSF, and plug-in the wideband LSU sensor into the 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-II, 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 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-II, which will ramp up the heating power smoothly.

Chapter 5 ALM-II hardware connections

5.1 ALM-II main connector pin-out



Connector	Pin#	Wire#	Name	Description	Min	Max
POWER & ANOUT	1	White	ANOUT2	Lambda linear analog output 2(fine)	0V	5V
	2	Black	GND-R	Ground (Reference ground)	0V	0V
	3	Red	+12V	+12V Power supply	9V	15V
	4	Blue	ANOUT1	Lambda linear analog output 1(fine)	0V	5V
	5	Black	GND-H	Ground (Heater circuit ground)	0V	0V
I/O	1	Grey	VIN2	analog input 2 (optional EGT sensor)	0V	5V
	2	Purple	RPM	injection signal input	0V	12V
	3	Green	NBOUT1	Simulated narrow band oxygen sensor output	0V	1V
	4	Yellow	NBOUT2	Simulated narrow band oxygen sensor output	0V	1V
	5	Black	GND-R	Ground (Reference ground)	0V	0V
	6	White	VIN1	analog input 1 (optional MAP sensor)	0V	5V
O2#1	1	Red	IP	wideband oxygen sensor input	—	—
	2	Yellow	VM		—	—
	3	White	H-		—	—
	4	Grey	H+		—	—
	5	Green	IA		—	—
	6	Black	UN		—	—
O2#2	1	Red	IP	wideband oxygen sensor input	—	—
	2	Yellow	VM		—	—
	3	White	H-		—	—
	4	Grey	H+		—	—
	5	Green	IA		—	—
	6	Black	UN		—	—

LSU sensor connector:



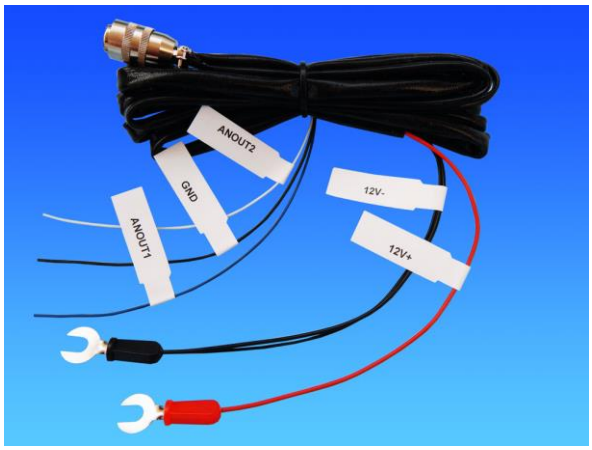
Note: LSU4.9 pin-out numbers are different than LSU4.2, but they have the same color scheme. The pin-out of LSU4.9 are the same as the LSU-ADV, but the 5th pin (IA) of LSU-ADV is reserved.

5.2 Installation Procedures

1) Plug-in the connector from the harness into ALM-II
2) Connect the 6-pin LSU 4.9 mating connectors to the O2 sensor.



3) Connect the 12V+ wire (red)to 12V battery plus or the DC power supply +;

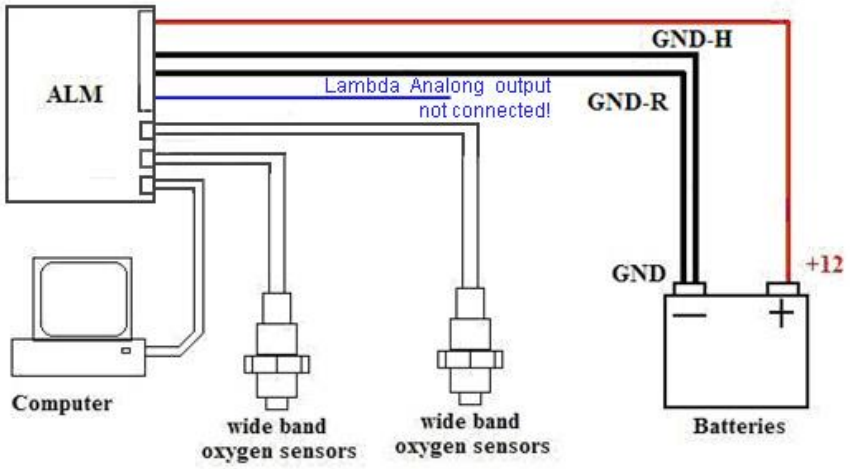


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4) Connect the 12V- (heater circuit ground) to 12V battery minus or the DC power supply -;

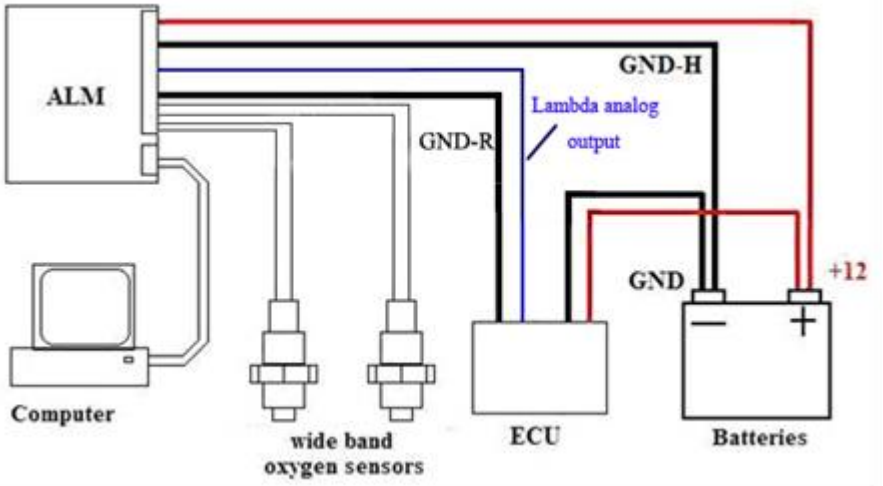
5) If you do not want to output the lambda analog signal to your ECU, connect the GND (reference ground, pin1) to the 12V battery minus or DC power supply ground; otherwise, refer to step 4.5 for GND connection.

Example of the ALM running alone:

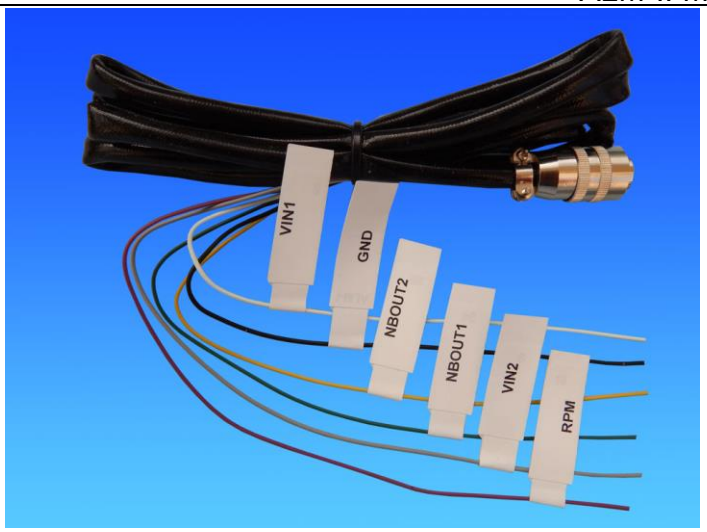


6) If you want to output the lambda analog signal to your ECU, connect the ALM-II lambda analog output to your ECU analog input, and then you must connect the ALM-II GND (reference ground, pin8) to the ECU analog GND (most likely your ECU has a sensor ground for analog inputs).

Example of connecting the ALM's analog output to an ECU as the feedback signal:



7) Optional: Splice the spark-driver wire on the ECU side (usually low-side-driver type), and tap the ALM-II RPM input wire to it. Use the electrical tape to wrap it.



8) Optional: connect your extra analog inputs to ALM-II: MAP sensor or EGT sensor or both. The sensor GND and power lines can be tapped into ALM-II GND and power line; Note, your MAP sensor and EGT sensor can be different than the ones ALM-II supports by default. It's your responsibility to figure out the right way to connect them.

9) Optional: connect an analog narrowband oxygen sensor output (NBOUT) to the OEM's ECU. This can prevent the OEM ECU turn on the MIL light. Note, the OEM switching sensor can be different from each other, and it's your responsibility to figure out how to connect the wires correctly.

10) Optional: connect ALM-II to your laptop / PC via the serial communication cable (DB9 connector). If your computer does not have a serial port, you need an extra USB-RS232 converter.

11) Users can set the ANOUT analog output to correspond to AFR, Lambda, or oxygen concentration. We will set it in our factory according to the uses' requirement. The standard ANOUT output is AFR. If users want it to output lambda or O2%, users can modify it by using ALM GUI. Connected ALM-II to computer, click Settings→ALM Parameters, open ALM Parameters window. You can select what you want to modify the ANOUT output and Burn to ALM.

Users can use the ALM GUI software to connect the ALM-II. This software can display Lambda, AFR, O2%, O2 sensor temperature; calibration ANOUT and set ANOUT output range; read fault codes; record and playback data, etc.

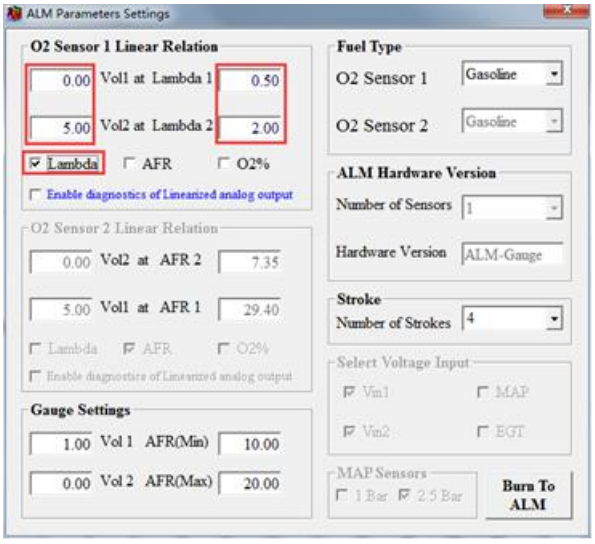
About ALM GUI usage, please refer to the ALM GUI Manual.

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

5.3 ANOUT Calibration

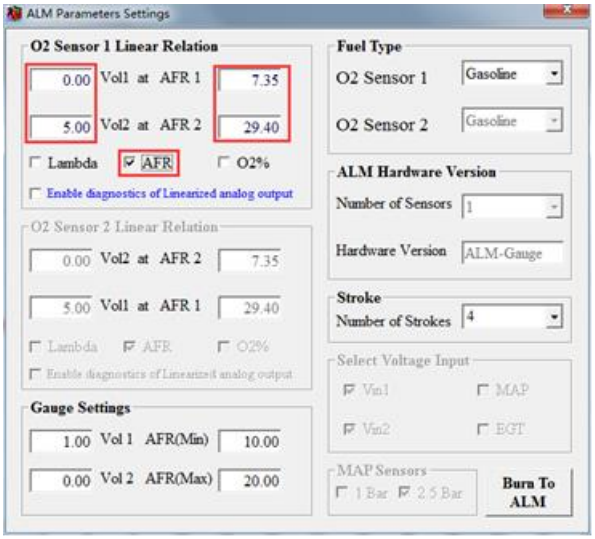
Lambda mode, ANOUT used to indicate changes in lambda, the default setting:

0.00 Volt at Lambda 0.50
5.00 Volt at Lambda 2.00



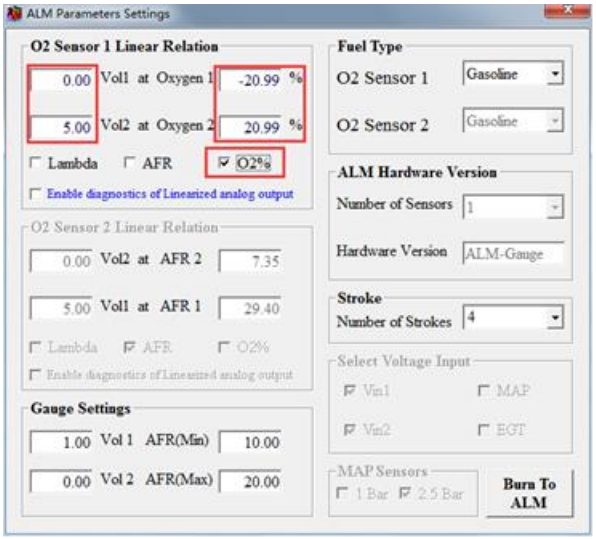
AFR mode, ANOUT used to indicate changes in AFR, the default setting:

0.00 Volt at AFR 7.35
5.00 Volt at AFR 29.4



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, customers can refer to the 2.4 chapter 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-II has on-board-diagnostics capability to detect most common errors. The first thing user should do when ALM-II 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	Contact the manufacturer
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