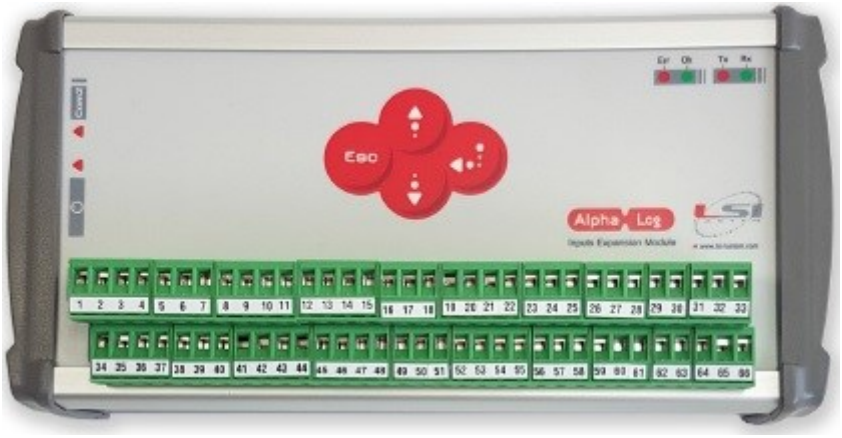

ALIEM

Alpha-Log Input Extension Module

User manual

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Revision list

Issue	*Date*	*Description of changes*
Origin	06/05/2020	
1 (a)	21/06/2021	General revision based on a new board called “HW V3”
2	21/09/2022	Added the Declaration of conformity. Made minor changes
3	23/12/2022	Updated technical specifications
4	20/07/2023	Added chapter on the use of 2-wire current sensors (current loop); made minor changes

Notes on this manual

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LSI LASTEM reserves the right to intervene on the product, without the obligation to promptly update this document.

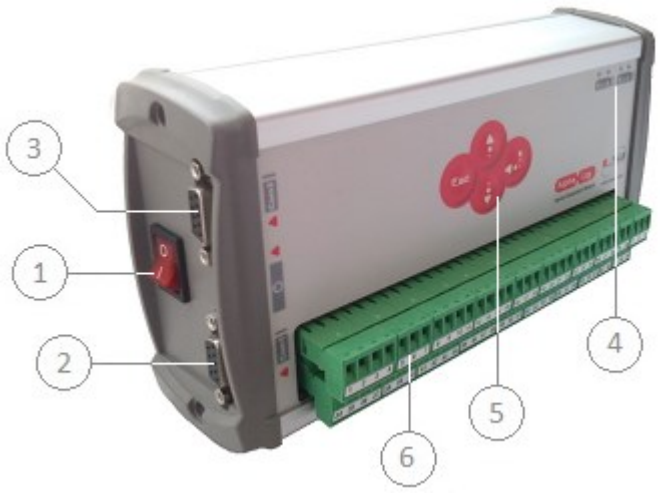
Table of contents

1 Introduction

ALIEM (*Alpha-Log Input Extension Module*) is the input extension module of Alpha-Log.
The module acquires the punctual values of the measurements relating to the sensors connected to it and makes them available to Alpha-Log via the Modbus RTU® protocol.

2 Instrument description

ALIEM is presented as in Fig. 1.



(1) - On/Off switch
(2) - Com1 serial port (PC)
(3) - Com2 serial port (Alpha-Log)
(4) - Operating status LEDs
(5) - Keyboard
(6) - Terminal board

Fig. 1 – Instrument description.

On the ALIEM frontal side are located the 4-buttons keyboard (5), reserved for the use of LSI LASTEM staff, the LEDs (4) that indicate the operating status of the instrument, and the terminal board (6) with removable screw connectors for the connection of sensors, power supply and external devices. For details, refer to Fig. 2.

On the left side panel there is the power switch (1) of the instrument, the RS-232 Com1 serial port (2) for PC connection and the Com2 serial port (3), RS-232 or RS-485 depending on the model, for connection to Alpha-Log.

2.1 Power supply

Please refer to the table below for the inbound power terminal connections to the instrument and outbound to the sensors or devices that need to be powered.

Line	Connection	Terminal
Inbound	0 Vdc battery	64
	+ 8÷30 Vdc battery	65
	GND	66
Outbound	+ Vdc fixed to power sensors / external devices	31
	0 Vdc	32
	+ Vdc actuated to power sensors / external devices	33

Whenever available, connect the ground wire (GND) to terminal 66. If the round wire (GND) isn't available, you make sure to connect terminals 60 and 61 (short circuit). This measure will improve the immunity from electromagnetic noises and the protection from induced and conduced electrical discharges.

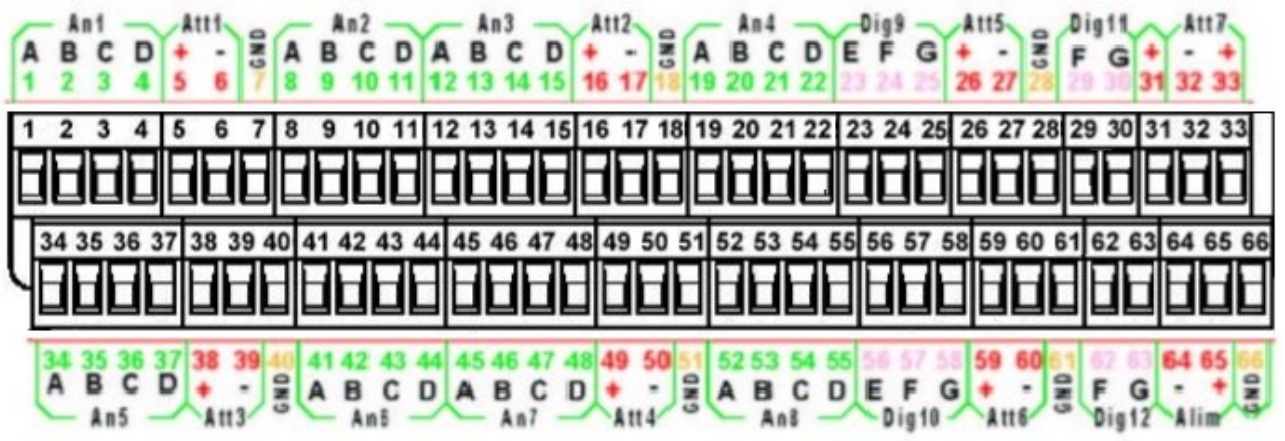
WARNING! In case the 31 and 32 terminals feed outside equipments, they must be equipped with power fail circuit against short circuits or absorbed currents above 1 A.

2.2 Inputs and actuators

The instrument is fitted with 7 actuators used to power the sensors connected to the terminal board, (4 actuators for 8 analogue inputs in *differential* mode and 16 in *single-ended* mode, 2 actuators for 4 digital inputs, 1 actuator for other functions); the actuators can also be used by the actuation programmable logics, than can produce alarms according to the values acquired by the sensors. The voltage available on these terminals depends on the kind of power supply received by the instrument.

Use the program *3DOM* (see SWUM_00339 available on *www.lsi-lastem.com* website) to configure the operation to switch on the sensors by means of the switching powers. In order to choose the actuation time is advisable to consider both the energetic saving and the time the sensor needs to initialize.

The association between input and switching power is fixed, as shown in the table below. The number of the terminal is indicated in italics; for example, that inputs 1 and 2 both make use of the first actuator; therefore, it cannot be used for the other inputs. In case of sensors that generate two signals (like the thermo-hygrometric sensor), it's suitable to select both inputs that use the same actuator.



Analogue input	Terminal board				GND	Actuator		
	A	B	C	D		Number	+V	0 V
An1	1	2	3	4	7	Act1	5	6
An2	8	9	10	11				
An3	12	13	14	15	18	Act2	16	17
An4	19	20	21	22				
An5	34	35	36	37	40	Act3	38	39
An6	41	42	43	44				
An7	45	46	47	48	51	Act4	49	50
An8	52	53	54	55				

Digital input	Terminal board			GND	Actuator		
	E	F	G		Number	+V	0V
Dig9	23	24	25	28	Act5	26	27
Dig10	56	57	58				
Dig11	-	29	30	61	Act6	59	60
Dig12	-	62	63				
				28	Act7	33	32

Fig. 2 – Terminal board.

2.2.1 Differential mode inputs

The differential mode is the one commonly used for the connection of sensors, in which a sensor occupies a single input.
It is preferable to the single-ended mode as it is less subject to electrical noise.

The following pictures explain in detail the connections of all types of sensors, both analogue in differential mode and digital.

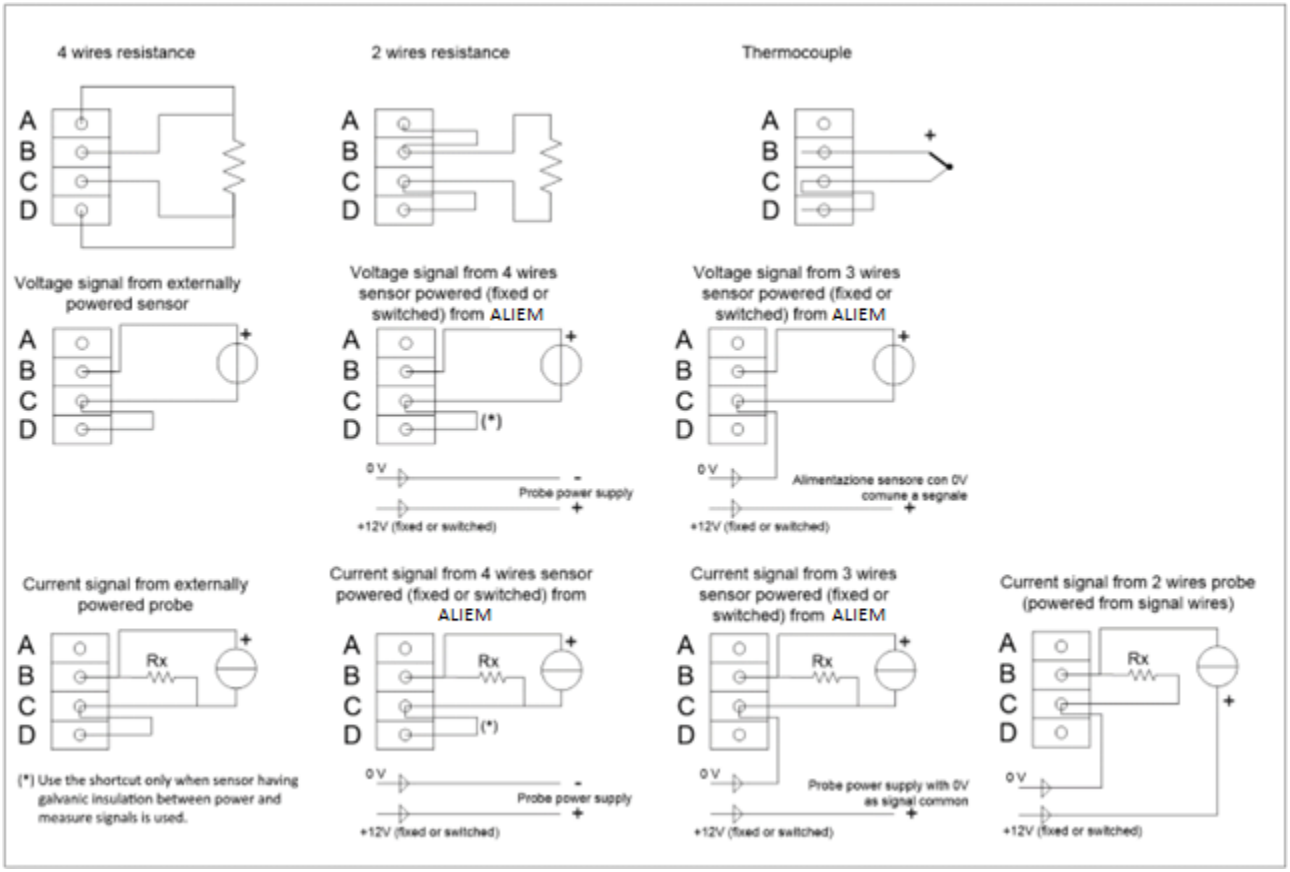


Fig. 3 – Connection diagram for sensors with analog signal (*differential* mode).

The drop resistance, indicated by *Rx*, is used to return a voltage signal from the current generated by the sensor. Program *3DOM* supplies a library for the setting of the LSI LASTEM sensors, including some powered outputs; for such models the settings have been arranged to use the energized scale -300÷1200 mV, thus being able to use 50 Ω drop resistances.

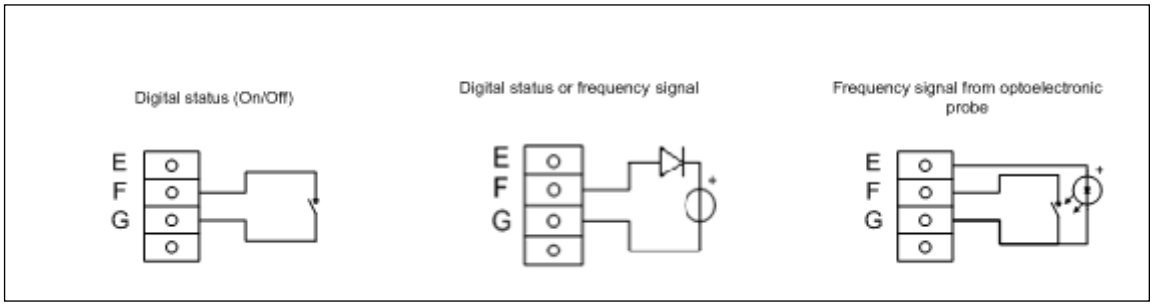


Fig. 4 – Connection diagram for sensors with digital signal.

2.2.2 Single-ended inputs

Single-ended is a connection mode that allows you to double the number of analog inputs of ALIEM. In this mode two sensors that have voltage or current signals can be connected to the same input. It is not applicable to sensors with resistive signals.

Single-ended mode is more subject to electrical noise, therefore the differential mode, in which a sensor occupies a single input, is preferable when you want to obtain the best measurement performance from the instrument.

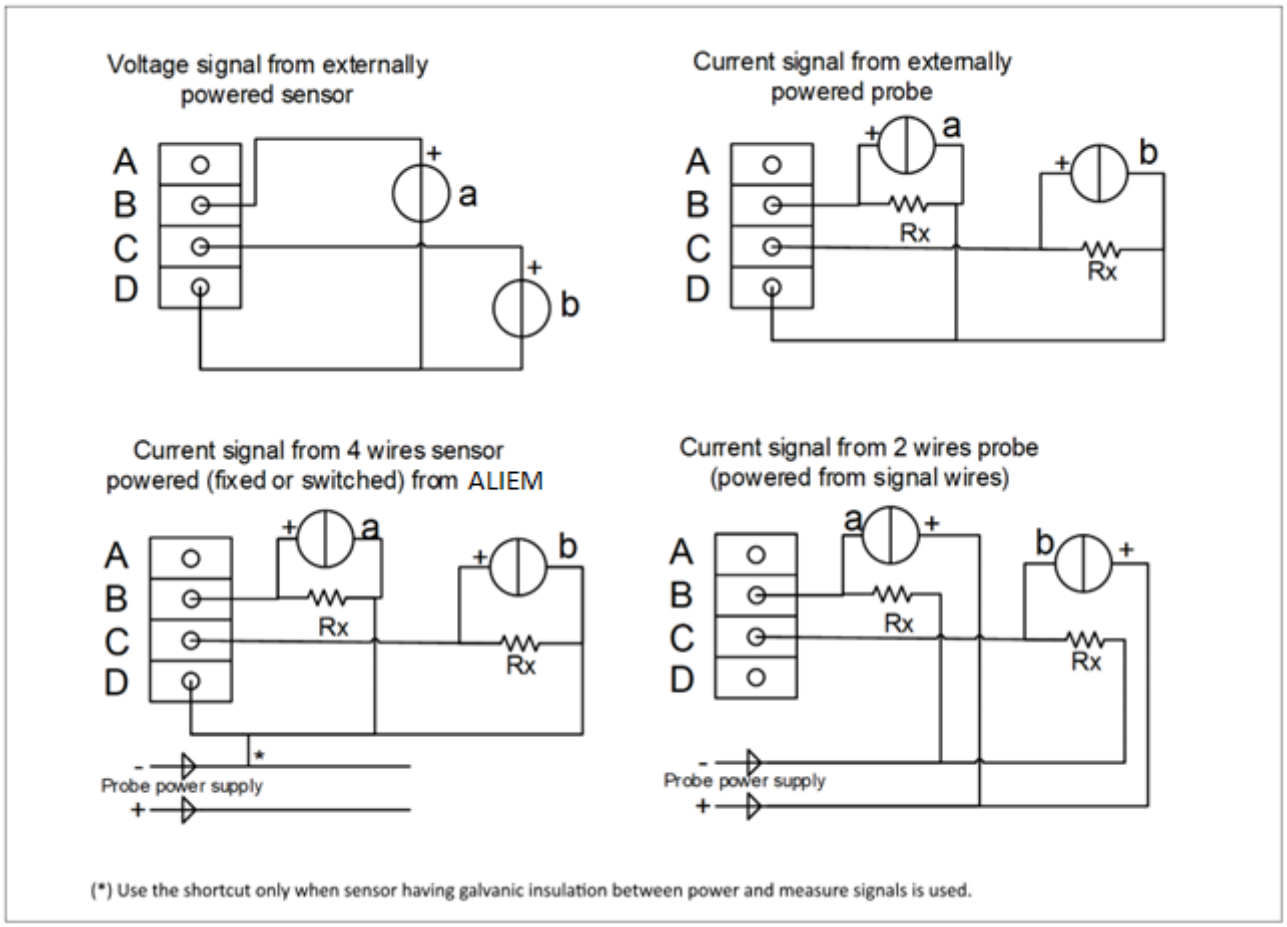


Fig. 5 – Connection diagram for sensors with analog signal (*single-ended* mode).

The drop resistance, indicated by *Rx*, is used to return a voltage signal from the current generated by the sensor. Program *3DOM* supplies a library for the setting of the LSI LASTEM sensors, including some powered outputs; for such models the settings have been arranged to use the energized scale -300÷1200 mV, thus being able to use 50 Ω drop resistances.

When a probe is added using the 3DOM probes library, those sensors are always added in differential mode; for this reason is not possible add a single-ended probe to a configuration where there is only one single-ended sensor free; when this situation occurs set the measure parameters manually matching the single-ended probe needs; otherwise change, if possible, different measures from differential to single-ended mode until obtaining a complete differential input free (two single-ended sequential inputs).

2.2.3 Considerations on the use of 2-wire current sensors (current loop)

When using current sensors with 2-wire connection, which require power supply via the same connection as the measurement signal (current loop), it is advisable to consider the voltage drop given by the overall resistance placed in series with the current circuit (that relating to the ALIEM measurement circuit added to

that of any other utilities for the measurement of the same signal) in order to evaluate whether the sensor is powered with the correct voltage in all operating conditions.

Suppose, for example, that we have a sensor that requires a minimum supply voltage of 12 V DC and that we have connected it to the ALIEM terminals where the 50 Ω resistor is connected (as indicated in the module manual) and suppose that ALIEM supplies a voltage equal to 12.5 V on the same terminals. When the sensor measurement is close to the full scale, the value of the current signal also reaches the full scale, therefore about 20 mA; in that measurement condition the voltage drop approaches 1 V and this value causes the sensor to be powered with a voltage of about 11.5 V, a value not compatible with the minimum operating requirements of the sensor; this situation can sometimes be difficult to identify, since any sensor malfunction or measurement error can occur sporadically, only under certain measurement conditions. If it is estimated that the above operating conditions exist, implement one of the following possible solutions:

- Reduce the value of the resistor used in series with the circuit; consequently, modify the scale parameters configured in ALIEM; however, this determines the reduction of the resolution obtained from the measurement of the current.
- Increase the supply voltage of ALIEM, respecting the limits of both the module itself and the sensors connected and powered via its terminal block. The power supply voltage available at the ALIEM terminals corresponds to that of the power supply reduced by the voltage drop determined by an internal protection diode (about 0.6 V).
- Power the sensor with an additional power source with a higher output value than the one supplied by ALIEM.

2.3 Serial ports

MDMMB1110 is fitted with two RS-232 serial ports through 9-pole female standard connectors (DB9F). Serial port 1 (2) (located on the left-hand side panel, at the bottom near the terminals) is used to program the instrument's operative modes and data download, by means of the LSI CISS communication protocol. Serial port 2 (3), in addition to the proprietary protocol, supports the TTY, LSI Probe and Modbus RTU® protocols.

The factory configuration sets the RS-232 serial ports as follows:

Serial port	1	2
Protocol	Native CISS	Modbus RTU
Speed	9600 bps	115200 bps
Data bit	8	8
Stop bit	1	1
Parity	None	None
Network address	1	1
Flow control	RTS only	RTS only

The instrument can be programmed; however only the *Speed*, the *Network address* and the *Flow control* can be changed; all other parameters cannot. The speed can be programmed from 1200 to 115200 bps.

Electrically speaking, both RS-232 ports are configured as a DCE device. The following table shows the meaning of each serial connectors' pin:

Signal	Pin
TD	2
RD	3
GND	5
RTS	8
CTS	7

The MDMMB1110.1 model has RS-485 serial line 2 instead of RS-232. The DB9 adapter/terminal block, shown in the figure, is supplied for connecting the RS-485 device.

It must be connected as per the following table:

Signal	Pin
D+ / Data+	2
D-/Data-	3
GND	5

The factory configuration of the RS-485 serial port is as follows:

Serial port	**2**
Protocol	Modbus RTU
Speed	115200 bps
Data bit	8
Stop bit	1
Parity	None
Network address	1
Flow control	RTS only

The configurable parameters are the same as the RS-232 port, namely the *Speed*, the *Network Address* and the *Flow Control*.

For more information on changing the parameters, refer to the user manual SWUM_00339.

3 Product installation

3.1 General safety standards

Read the following safety standards to avoid personal injuries and to prevent damages to this product or to the devices connected to it. Use this product strictly in the indicated way to avoid damages.

Only the support staff is authorized to perform the setup and managing procedures.

Install the instrument in a clean, dry and safe place. Humidity, dust and extreme temperatures tend to ruin or damage the instrument. In these particular environments, it's recommended to install the instrument in appropriate protective boxes.

Power the instrument properly. Observe the power voltage indicated for the instrument model owned.

Connect the instrument properly. Follow meticulously the wiring diagram provided with the equipment.

Do not use the product if a malfunction presence is suspected. If the existence of a malfunction is suspected, do not power the instrument and ask for assistance to the qualified support staff.

Before any operation on electrical connections, power, sensors and communication devices:

- turn off the power
- discharge the accumulated electrostatic charges touching a conducting material or a grounded device

Do not start up the product if water or condensing humidity is present.

Do not start up the product in an explosive atmosphere.

Lithium ion battery inside. Replacing the battery with an incorrect type can cause an explosion hazard.

For safety regulations please refer to manual INSTUM_05290.

3.2 Mechanical installation and placing

ALIEM is usually used outdoor inside the appropriate protective boxes. However, indoor use is possible by placing the instrument on shelves or attaching it to a wall.

For its functioning it requires the dedicated power supply or a photovoltaic module with the proper battery.

For the mechanical installation see the documentation provided with the equipment.

4 3DOM software

3DOM is the LSI LASTEM's configuration software for the E/R/M/S-Log, Pluvi-ONE, Alpha-Log and ALIEM instruments. In Alpha-Log, it allows the user to:

- Create and modify the configurations.
- Send and receive the configurations through different kinds of connection.
- Import and export the configurations between different instruments.
- Check the constantly refreshed measurement values in the instrument.

3DOM can be downloaded from *www.lsi-lastem.com* website. To install the software, follow the instructions displayed on the Setup program.
See the online help guide for more information on 3DOM's usage.

4.1 Connection to PC

To connect ALIEM to PC, proceed as follows:

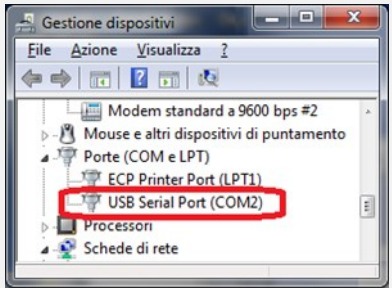
1. Insert the ELA105 serial cable to the ALIEM serial port Com1 (2) and to that of the computer. If the latter does not have an RS-232 serial port, use the USB RS-232 adapter supplied. In this case, allow the installation of the device driver.
2. Connect the power supply to the terminal (64-, 65+) of the terminal block (6).
3. Turn on ALIEM via the On/Off switch (1).

4.2 Entering the instrument in 3DOM and receiving the configuration

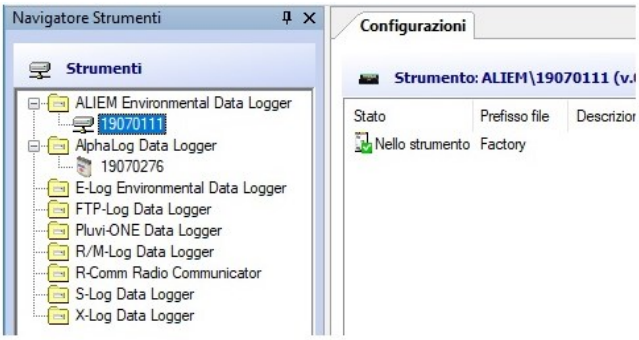
On 3DOM's first start, after the installation, you need to register the instrument you are using. Proceed as follows:

1. Start 3DOM.
2. Select *New…* from the *Instrument* menu
3. Select *E-Log – R/M-Log, S-Log, ALIEM…* and press **[Continue]** and then **[Next]**.
4. In the Communication parameters Window set:
   - Communication type: Serial.
   - Serial port: the port number of the PC to which it is connected (e.g. COM1).
   - Bit rate (bps): 9600.
5. Press **[Save]**, then **[Next]** to connect to the instrument. Continue by pressing **[Next]** and then **[Finish]**.

In Microsoft Windows, to check the PC serial port where the USB adapter is connected, select *System* in the *Control Panel* and select *Hardware setup*. Expand the Ports list *(COM and LPT)*. Identify the port number called USB Serial Port. In the case more than one USB port is listed, disconnect and reconnect the adapter and check with port will disappear and reappear. Set the same COM number in the 3DOM



6. To download the configuration choose *Yes*, then **[Continue]**. At the end, press **[Close]**, assign a name to the configuration (e.g. “Factory”) and press **[Ok]**.



3DOM will upload *Instruments Browser* and *Configurations* with the serial number of the instrument and the newly downloaded configuration.

5 Configuration

ALIEM comes with a factory standard configuration: set to acquire the internal temperature measurement (the related sensor is built-in) and the battery level.

If the factory configuration does not suit your usage wish, use the 3DOM software to customize ALIEM. This operation requires the instrument to be connected to a PC with 3DOM software installed (see §4).

For more information about the configuration of ALIEM, refer to the 3DOM manual.

6 Use of ALIEM

6.1 Start-up/Shutdown

Start-up and shutdown are controlled by the On/Off switch (1).

6.2 Use of the keyboard

The keyboard consists in four buttons: two of them are directional and the other two are functional. Its use is reserved for LSI LASTEM personnel.

6.3 Operating status LEDs

On ALIEM's front panel are some LEDs that indicates the instrument operative status: Err/Ok e Tx/Rx.

Err/Ok

These LEDs determine the operating status of the instrument. In particular:

- *Err:* it is red; if on it indicates the presence of an error in the instrument
- *Ok:* it is green; it has the following meanings:
  - *off*: instrument switched off, or low feeding voltage (min. 7 V)
  - *single quick blinkings*: instrument switched on; regular operation (acquisition mode)
  - *three quick blinkings*: instrument switched on; it operates in reconfiguration mode
  - *five quick blinkings*: the instrument is on; it operates in quick acquisition mode (reserved for the use of LSI LASTEM staff)

Tx/Rx

These LEDs light up to indicate that communication is in progress on any of the serial ports. In particular:

- *Blinking Tx:* it is red; it indicates the instrument being transmitted
- *Blinking Rx:* it is green; it indicates the instrument being received
- *Tx and Rx off:* no communication activity in progress

Interval between blinking cycles: 5 s.
Quick blinking period: 125 ms
Slow blinking period: 375 ms.

7 Insight ALIEM

7.1 Acquisition and calculation of measures

It is possible to acquire measures of sensors with a rate from 1 second to 12 hours; this allows a better representation of both fast-changing quantities (wind speed), as well as slow-changing ones (air temperature). It is possible to acquire as many as 10 measures per second.

For sensors which have to be powered, ALIEM is fitted with own outputs with switched power supply (see "actuators" §2.2).

The instrument is able to calculate quantities deriving from measures that sample the signs from the inputs: ALIEM is fitted with a calculation library dedicated to environmental applications, also able to carry out useful mathematical functions (see §0). ALIEM is able to acquire and calculate up to a maximum of 99 total measures. Furthermore, it's possible to program some calculated measures according to the data generated by other calculated measures.

Program *3DOM* can be used to program the measure sampling sequence: the program interface allows choosing the sequence in which the measures are displayed; hence which is the sampling sequence taking place during the survey. With *3DOM* you can also set automatically the measure sequence according to their acquisition rate (from the shortest to the slowest). This is important to gather measures which, during the acquisition process, must be sampled within the shortest intervals possible among each other (if they are allocated to only one actuator).

If configured with the same acquisition rate, the analogue channels following the first one will be sampled about 80 ms after the previous channel. This means that as many as eight analogue channels are sampled within a total time of 700 ms. Digital channels are instead sampled almost instantly.

7.2 Acquisition from thermocouples

ALIEM is able to acquire the signals from many types of thermocouples. The instrument uses the internal temperature value as reference of value of the cold junction.In these cases it is necessary to program, by means of the *3DOM* program, the measure of the internal temperature. The measure of the internal temperature must precede, in the measure sequence, all measures of quantities which use such reference.

7.3 Details about the measure acquisition process

The sampling of the signals produced by the sensors connected to the instrument's terminal board takes place according to the following logical procedure:

1) Measurement of the electrical signal based on its type (voltage, resistance, frequency, etc.) and its digital conversion into a 16-bit numeric value; the physical type of the sensor is programmed through parameter *Electrical measure type*;
2) Data validation: during this operation the value is limited within the scale values allowed by the physical type of measure;
3) Possible thermocouple value correction through the measure of the cold junction temperature (internal temperature of the instrument);

4) Linearization of non-linear signals based on the setting of parameter *Linearization type*; the linearization may also take place through the setting of a polynominal function whose factors are specified until 10° degree (section *Linear parameter* of *3DOM*);
5) Recalculation of the value according to numeric parameters defined in section *Parameters:*
   - Computation of the measured quantity through the defined initial and final scale values;
   - Application of the calibration factor of the specific used sensor (radiometers, rain gauges, etc.);
   - Selection of the logical state with reference to the analogue signal thresholds;
   - Measure validation after processing accompanied by error indication if greater (by 0.5%) than the limits set in output; wind direction and relative humidity are excluded;
   - Linearized quantity control: the instrument produces null output when receiving null input.

All above parameters are indicated in section *Measure properties* in the measure modification window of program *3DOM*.

7.4 Acquisition from status signal

ALIEM is able to acquire different types of digital status; they have to be configured for their connection to 9, 10, 11 and 12 inputs.

Ther are 3 different signal types: frequency signals, digital status and counters.
The default configuration of acquirer has been made for:

give logical status = 1	In case of short circuit or 0 V
give logical status = 0	In case of opened contact or 3 V

Furthermore, if one configuration for low power consumption is selected:

- for signals with frequencies over 1000 Hz it's better the input 9;
- for signals with frequencies under 1000 Hz, for counters and logical status they're better the inputs 11 and 12;
- do not configure the input 10 because it doesn't reduce the instrument's low power consumption.

If it's been selected one configuration with no attention to power consumption:

- for signals with frequencies over 1000 Hz use the inputs 9 and 10;
- for signals with frequencies under 1000 Hz and for logical status use any inputs among the available ones.

The sensors with status output that produce voltage (e.g. they aren't pure contacts "open/closed") but with variable voltage according to measured status, can be connected to ALIEM through one diode; in this way every connection is always the right one, apart from the output voltage (no divider is required). The anode of diode must be placed on clamp F of terminal board's entrance and the cathode towards the sensor.

LSI LASTEM recommended default configuration:

- input 9 for wind speed (frequency signal);
- input 10 for rain gauge (counter);
- input 11 for logical status.

7.5 Details about calculated measures

If the instrument has been programmed to process one or more calculated measures, the logical process will be the following:

1) Acquisition of all primary measures that allow the estimate of calculated measures; a calculated measure can be a primary measure for new calculated measure;
2) Collection of the value of primary measures; if at least one of these values is found to be in error, its calculated measure will also be indicated in error;
3) Collection of the value of standard parameters, whenever used in the calculation; the value of these parameters is decided during the configuration process and cannot therefore be modified during the survey;
4) Execution of the estimate;
5) Allocation of the calculated value to the measure's instant datum.

The acquisition rate of a specific calculated measure is setted by *3DOM* so that it may correspond to the acquisition rate smaller than the calculated measures it depends on.

7.6 Actuation logics

ALIEM has got an actuation logics library. It's useful to switch-on all type devices (alarms, solenoid valves, motors) according to the surveyed parameters in surrounding environment. The actuation logics are based on the instantaneous value of the acquired and calculated measures. They can be programmed up to 20 calculation algorithms, that use same or different logics. One or more algorithms can be combined in two differed modes, in order to switch-on the selected actuator:

1) All algorithms must be in alarm at the same time (AND logic);
2) One algorithm can be in alarm at least (OR logic).

The actuator's switch-on logic can operate according to *low power consumption* mode (the actuator is usually deactivated, and starts in case of alarm), or according to *safety* mode (the actuator is usually activated, and it shuts-down in case of alarm). Summarizing explanation in the table below.

Operating logic	***State***	***Actuator***
Low consumption mode	No alarm	Actuation output switched-off
	Alarm	Actuation output switched-on
Safety mode	No alarm	Actuation output switched-on
	Alarm	Actuation output switched-off

In case of one or several measures' error (for example owing to sensor breaking, no-scale acquisition, or disconnected cable) it doesn't modify the present state of the actuator piloted by the logic that uses the same measures.

The actuation logic deactivates the actuator only if it has previously activated from the logic itself.
The actuation logic begins operation after the first activation of the actuator, even if this occurs temporally after the deactivation.

The programming of the actuation logics happen by means of the *3DOM* program according to two different phases:

1) Selection of the logics and their calculation parameters (section Logics);
2) Selection of the actuation outputs and their AND or OR modes correlation with the preset logics (section Actuators); note that the same logic can be combined with other different logics several times, in order to switch over different effectors.

7.6.1 Eolic alarm

The logic uses a wind direction measure to establish the condition of a wind position in a specified sector for a predefined time. Can be set:

- The measure that samples wind direction (degrees);
- The starting angle (extreme included) of the direction sector;
- The ending angle (extreme included) of the direction sector;
- The continuous permanence time of the wind direction inside the defined sector in order to detect the alarm condition;
- The continuous permanence time of the wind direction outside the defined sector in order to detect the end of the alarm condition.

Both times can be set from 0 seconds to 12 hours; if both times are set to zero, the wind direction in or out conditions inside the sector are immediately detected.

It is possible to join this logic with an another logic of threshold bypass type (see §7.6.5) applied to a wind speed measure: in this way it's possible to refine further the alarm activation (e.g. to activate the alarm when the wind is more than 5 m/s for at least 3 minutes and inside the *Est* sector of 45 degree for at least 1 minute).

7.6.2 Evaporimeter filling

The logic uses a water level probe inside the evaporimeter to establish the need for filling up it.
It can be set:

- The measure that samples the water level;
- The filling-up start time (it's recommended the automatic filling-up programmed in the morning, before the sunrise, in order to avoid temperature changing that could alter the evaporation measure);
- The maximum filling-up time, useful to avoid flooding in case the water level sensor is broken or surveys a wrong measure;

- The maximum water level that determines the stop of the filling;
- The minimum water level, under that the need for the evaporimeter filling-up (at the defined time), is detected. To obtain the right evaporation keep the evaporimetric basin always filled. Therefore set the minimum level like the maximum level, because, in case of too low water level, the shade of the walls on the surface of the water doesn't allow the right evaporation in the morning and in the evening.

7.6.3 Start precipitation alarm

The logic uses a measure connected to a rain gauge to detect the start precipitation conditions.
It can be set:

- The measure that samples the precipitation;
- The minimum time T1 after the first precipitation detection by means of the rain gauge (instantaneous value > 0);
- The minimum time T2 that must elapse after the detection of rain, meanwhile no precipitation occurs (absence of signal from the rain gauge), to determinate the end of rain condition;
- The minimum precipitation quantity that determines the start of the precipitation condition.

The alarm condition is detected when T1 time has elapsed since the first rain detection (and it's raining again), or is reached the specified rain quantity; anyway, if T2 time is passed without any rain detection, the system return to the non-alarm condition.

7.6.4 Flood alarm

The logic uses a measure connected to a rain gauge to detect flooding conditions. It can be set:

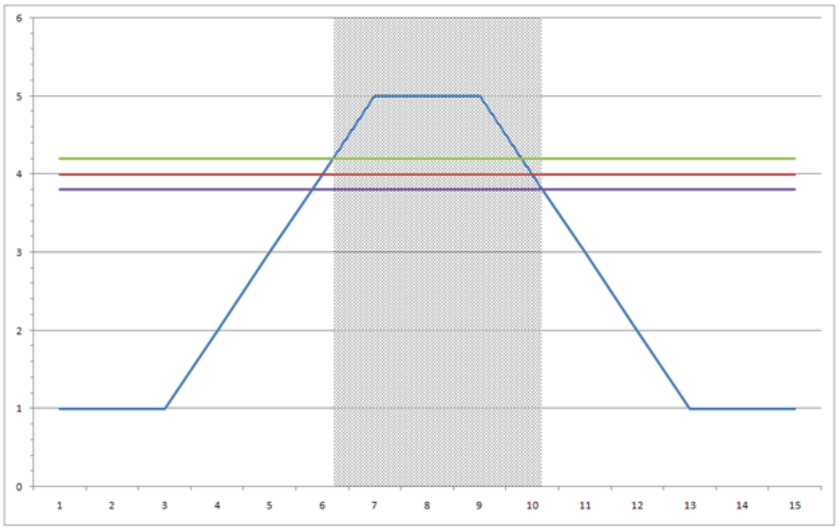
- The measure that surveys the precipitation;
- The maximum precipitation quantity in a defined period;
- The minimum precipitation quantity in the same period;
- The length of alarm or not alarm period.

The alarm condition is detected when, within the specified period that starts from the first precipitation event, the maximum precipitation quantity is exceeded; from alarm condition beginning or at the end of the first period, are managed new periods and for each of them the rain totalization starts from zero; for each new period, if the rain fall quantity returns below the specified minimum value, the system returns in no alarm condition.

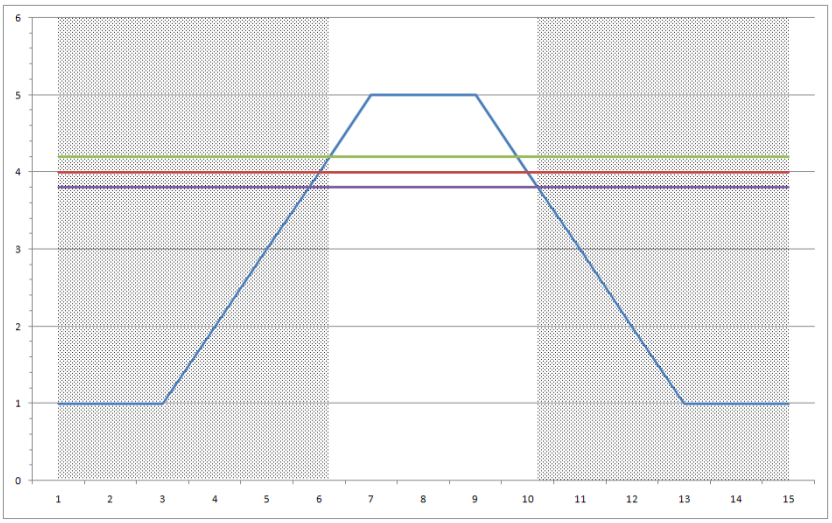
7.6.5 Threshold value compare

The logic detects value overflow or underflow by one or more measures (both univocally and simultaneously). To the threshold values can be applied a further hysteresis value; this can avoid continuous alarm state changes in case the measure value moves nearly around the threshold value. The comparison logics are the following:

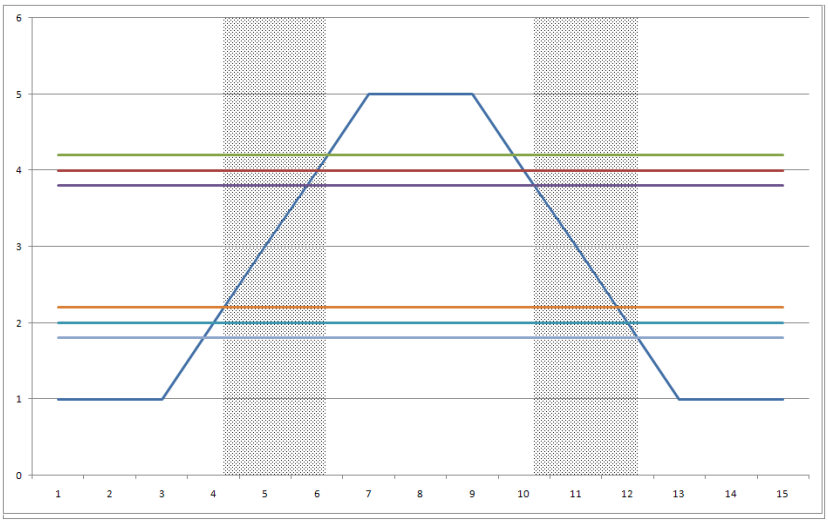
- *Greater than*: alarm in case the measure value if greater than the threshold value added to the hysteresis; return to no alarm condition when the measure value in less than the threshold value minus the hysteresis; e.g. threshold value=4.0 and hysteresis=0.2 (alarm in shaded area):



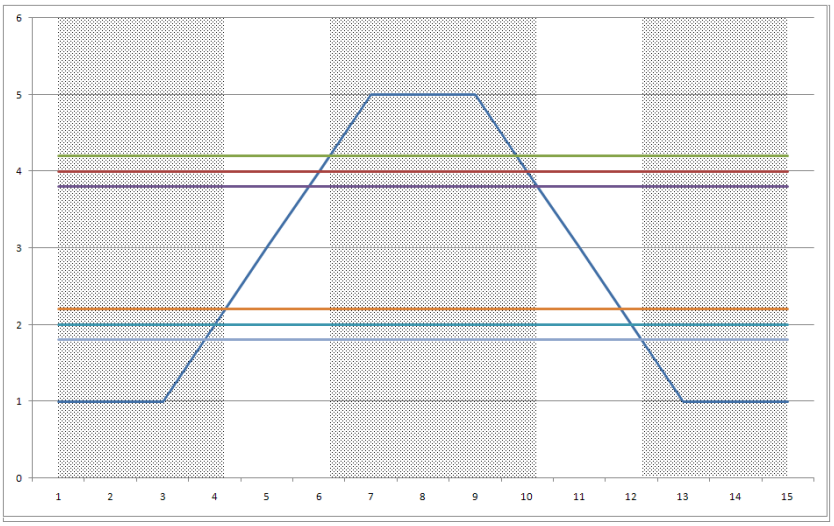
- *Less than*: alarm in case the measure value is less than the threshold value minus the hysteresis; return to no alarm condition when the measure value is greater than the threshold value added to the hysteresis; e.g. threshold value=4.0 and hysteresis=0.2 (alarm in shaded areas):



- *Included*: alarm in case the measure value if greater than the minimum threshold value and at the same time less than the maximum threshold value; return to no alarm condition when the measure value is less than the minimum threshold value or greater than the maximum threshold; hysteresis is used like shown in the following example: threshold values=2.0 and 4.0 and hysteresis=0.2 (alarm in shaded areas):



- *Excluded*: alarm in case the measure value if less than the minimum threshold or greater than the maximum threshold; return to no alarm condition when the measure value is greater than the minimum threshold and at the same time less than the maximum threshold; hysteresis is used like shown in the following example: threshold values=2.0 and 4.0 and hysteresis=0.2 (alarm in shaded areas):



Threshold value compare algorithm can be applied to one or more measures; in the last case all used measures must be consecutively ordered (the list cannot include any measures that shouldn't be considered in the comparing), because the logic programming needs the ordinal numbers of the first and last measure. This logic can be programmed to detect the alarm condition only if all measures (that belongs to the selected set) or alternatively only one of them are contemporary over the stated limit.

Furthermore, it's possible specify a minimum time (during that the measure stays over the set threshold value) to enter into the alarm condition and a minimum time to exit from the alarm condition. It can be done applying the algorithm to only one measure (e.g. it isn't possible to program the minimum times if two or more measures have been selected).

7.6.6 Timer

The timer logic allows: to activate or deactivate the actuator in two different times in the day, or alternatively to define a timed cycle on/off status. It can be set:

- Timer type (cyclic or time);
- The power-on delay after the initial instant determined by the cycle;
- If timer type is cyclic, the on and off statuses duration; the first cycle starts in the day time when the instrument clock time, divided by the sum of the two durations, returns zero as remainder; in this way the first cycle starts in a precise day time, not at any moment (e.g. if has been programmed 15 minutes *On* period duration, and 45 minutes *Off* period duration, the first cycle starts at the first hour and zero minutes after the instrument survey is started); the next cycles happen at set on/off times.
- If timer type is not cyclic, the day time of power on the actuator, and the day time of power off.

This logic is joinable with other logics in *AND* mode, for example to allow the alarms activation only in specified hours of the day.

7.6.7 Snow level alarm

The logic detects excessive snow fall conditions in indeterminate time period; the alarms condition stays active during programmable time; at the end of this alarm period the snow level starts to be counted from the actual level; if during the alarm condition the snow level decreases (owing to melting or compression), the snow level start value (used like reference value in the next delta calculation) updates accordingly. It can be set:

- The measure that samples the snow level;
- The maximum delta (centimetres), over that the system goes in alarm condition;
- The alarm duration before its automatic reset.

7.6.8 System errors

The logic sets an alarm when the instrument detects and internal malfunction.

7.7 Function library for derived calculations

ALIEM has a useful library containing deriving quantities, featuring application functions dedicated to both indoor (microclimate) and outdoor (meteorology) environmental sectors.

The list below shows all calculation functions available:

- **Arithmetical calculations**
  - Addition-summation
  - Subtraction
  - Multiplication
  - Division

- **Statistical/mathematical operations**
  - Integral
  - Mean
  - Power
  - Exponential
  - Natural logarithm and base 10
  - Square root

- **Mobile calculations**
  - Minimun, average, maximum
  - Totalization
  - Angular average

- **Thermo-hygrometric quantities (UNI EN ISO 7726, ISO/WD 7730, VDI 3786)**
  - Relative humidity with psychrometric calculation (dry/humid bulb)
  - Absolute humidity
  - Specific humidity
  - Mixing factor (ratio)
  - Humid air enthalpy
  - Dew point temperature
  - Partial steam pressure
  - Humidity index (HI)
  - Discomfort of heat index
  - Indoor and outdoor WBGT index
  - Wind chill index
  - Chill temperature (TCH)
  - Mean radiant temperature
  - Radiant temperature asymmetry
  - Average planar radiant temperature
  - Planar temperature side 1 and side 2
  - Percentage of dissatisfied people due to radiant temperature asymmetry from wall or ceiling
  - Dissatified floor temperature
  - Dissatified vertical temperature

- Draught rating
- Operative temperature

- **Duct flow**
  - Air speed from differential pressure (Pitot or Darcy)
  - Volumetric air and mass flow
  - Number of air changes

- **Radiometry**
  - Insolation time
  - UV index (DLE)
  - UV exposure level
  - Light intensity
  - UVA density
  - Day light factor

- **Actuators operations(*)**
  - Actuation status calculated with AND operator
  - Actuation status calculated with OR operator
  - Actuation logics status calculated with AND operator
  - Actuation logics status calculated with OR operator

- **Others**
  - Evaporation calculation based on the evaporimeter level
  - Soil volumic humidity with permittivity
  - Atmospheric pressure at sea level
  - Total count
  - Delta with previous value
  - Reprocess measure
  - Correct level

With *3DOM* you can choose which quantities to have the instrument calculate and select the direct measures which allow their calculation.

Some calculations, frequently used in agro-meteorology, such as wind direction or integral radiation, are easily obtained from the integral mathematical calculation.

8 Maintenance

ALIEM does not require particular maintenance if installed according to what is described in §0.

However, it's recommended that LSI LASTEM staff performs a periodic inspection of the entire system (ALIEM and the sensors connected), in order to detect and fix possible measurement errors.

9 Configuration templates

9.1 ALIEM configuration for Type 1: Alpha-Log + ALIEM

Sensor	Quantity
DNA121	Wind Speed+Dir
DPA154	Global Rad.
DQC102	Evaporation
DLE124	Contact temperature
DQC001.15	Water level

Sensor code	Measure (MU)	Acq. rate hh:mm:ss	Elaborations (hh:mm rate – type)
DNA121	WindSPEED (m/s)	00:00:02	00:10 - Min, Ave, Max, StdDev 01:00 - Min, Ave, Max, StdDev
	WindDIR (°N)	00:00:02	00:10 - PrevDir, ResDir, ResSpe, DirStdDev, %Calm 01:00 - PrevDir, ResDir, ResSpe, DirStdDev, %Calm
DPA154	GLOBalRad (W/m^2)	00:00:10	00:10 - Min, Ave, Max, StdDev 01:00 - Min, Ave, Max, StdDev
DQC102	EVAPLevel (mm)	00:00:10	00:10 - Min, Ave, Max, StdDev 01:00 - Min, Ave, Max, StdDev
	EVAPoration (mm)	00:00:10	00:10 – Tot 01:00 – Tot
DLE124	TeSURFace (°C)	00:01:00	00:10 - Min, Ave, Max, StdDev 01:00 - Min, Ave, Max, StdDev
DQC001.15	LEVEL (m)	00:01:00	00:10 - Min, Ave, Max, StdDev 01:00 - Min, Ave, Max, StdDev Last 60 min – Mobile min Last 60 min –Mobile max increase

10 Technical specifications

Models ALIEM

Code	MDMMB1110	MDMMB1110.1
Description	ALIEM - Alpha-Log Input Extension Module	
Analog inputs	8 differential (16 single ended)	
Digital inputs	4 (on/off or frequency/counter)	
RS-232 serial port	2	1
RS-485 serial port	NO	1
On/off outputs	YES	YES
Internal battery	NO	NO
Included accessories	RS-232/USB adapter, RS-232 cable, DIN bar mounting	RS-232/USB adapter, RS-232 cable, adapter for RS-485 cable wires, DIN bar mounting

Common features

	Type	Range	Resolution	Accuracy	
Analog inputs	Voltage	-300 ÷ 1200 mV	40 µV	±100 µV (@ 25°C)	-0.2 µV/°C (@ -10 ÷ 25 °C) +0.2 µV/°C (@ 25 ÷ 45 °C)
		±78 mV	3 µV	±35 µV (@ 25°C)	-0.2 µV/°C (@ -10 ÷ 25 °C) +0.2 µV/°C (@ 25 ÷ 45 °C)
		±39 mV	1.5 µV	±25 µV (@ 25°C)	-0.2 µV/°C (@ -10 ÷ 25 °C) +0.2 µV/°C (@ 25 ÷ 45 °C)
	Pt100	-50 ÷ 125 °C	0.003 °C	±0.5 °C (@ 25°C)	+0.0035 °C/°C (@ -10 ÷ 45 °C)
		-50 ÷ 600 °C	0.013 °C	±0.11 °C (@ 25°C)	+0.0035 °C/°C (@ -10 ÷ 45°C)
	Resistance	80 ÷ 140 Ω	0.0013 Ω	±0.02 Ω (@ 25°C)	+0.28 Ω/°C (@ -10 ÷ 45 °C)
		80 ÷ 320 Ω	0.005 Ω	±0.05 Ω	
		0 ÷ 6000 Ω	0.19 Ω	±1.5 Ω	
	Thermocouples	E-IPTS 68	< 0.1 °C	±1.5 °C	
		J-IPTS 68	< 0.1 °C	±1.2 °C	
		J – DIN	< 0.1 °C	±1.2 °C	
		K-IPTS 68	< 0.1 °C	±1.9 °C	
		S-IPTS 68	0.22 °C	±4.9 °C	
		T-IPTS 68	< 0.1 °C	±1.4 °C	

Analog inputs (…continue)	Inputs number	8 differentials (16 single-ended)
	Voltage clamping	±2.5 V
	ESD protections (complies standards)	IEC 61000-4-2 Contact Discharge ±12 kV IEC 61000-4-2 Air-Gap Discharge ±15 kV IEC 61000-4-5 Surge 3.0 A (8/20 µs)
	EMC filter	X2Y filters on all inputs
	Channel to channel crosstalk	-80 dB
	Temperature error (@-10 ÷ 30 °C)	300 ÷ 1200 mV < ±0.01 % FS ±39 mV < ±0.01 % FS ±78 mV < ±0.01 % FS

Digital inputs	Inputs number	4
	Mode	4 inputs for frequency/counters/logic state On-Off (0 ÷ 3 Vdc) of which: • 2 inputs for sensors with optoelectronics (freq. max 10 kHz) • 2 frequency inputs (max 5 kHz)
	Max. input freq.	5 kHz
	Accuracy	3 Hz @5 kHz
	Protections (power supply)	Potenza di picco dell'impulso: • 600 W (10/1000 µs) • 4 kW (8/20 µs)

	Protections (complies standards)	• IEC 61000-4-2 level 4:
		  ○ 15 kV (air discharge)
		  ○ 8 kV (contact discharge)
		• IEC 61000-4-5
		• MIL STD 883G, method 3015-7: class 3B
		  ○ 25 kV HBM (human body model)

Switched power supply outputs	Number	7 (with programmable switching-on time before sensor acquisition)
	Max. current	1.1 A per output (7.7 A total for all outputs)
	Voltage clamping	33 V
	Protections	On each output: PTC PTC overcurrent protections (resettable) max. 1.1 A
	Protections (power supply)	Peak pulse power: • 600 W (10/1000 µs) • 4 kW (8/20 µs)

	Protections (complies standards)	• IEC 61000-4-2 level 4:
		  ○ 15 kV (air discharge)
		  ○ 8 kV (contact discharge)
		• IEC 61000-4-5
		• MIL STD 883G, method 3015-7: class 3B
		  ○ 25 kV HBM (human body model)

Power supply	Power supply	8 ÷ 30 Vdc
	Consumo @12V	During acquisition: 115 mW Stand-by: <4 mW
	Voltage clamping	33 V
	Protections	From reverse polarity
	EMC filter	YES (AEC-Q200)
	Protections (power supply)	Peak pulse power: • 600 W (10/1000 µs) • 4 kW (8/20 µs)

	Protections (complies standards)	• IEC 61000-4-2 level 4:
		  ○ 15 kV (air discharge)
		  ○ 8 kV (contact discharge)
		• IEC 61000-4-5
		• MIL STD 883G, method 3015-7: class 3B
		  ○ 25 kV HBM (human body model)

RS-232 serial ports	Number	2 (1 for ELO3305.1 and ELO3515)
	Interface	DB9 female (DCE)
	Speed	1200 ÷ 115200 bps
	Data bits, Parity, Stop bits	8, None, 1 (not cheangeable)
	How to use	• Serial port 1 for connection to PC • Serial port 2 for connection to Alpha-Log (Modbus RTU® protocol)

RS-485 serial port	Number	1 (only MDMMB1110.1)
	Interface	DB9 female
	Speed	1200 ÷ 115200 bps
	Data bits, Parity, Stop bits	8, None, 1 (not cheangeable)
	How to use	Connection to SCADA/PLC systems (Modbus RTU® protocol)
	Power supply	Isolated 12 V @160 mA

Miscellaneous	Standard protection	EN 61326-1 2013, EN 61010-1 2013, EN 50581 2013
	Watch	Accuracy: 30 s/month (@ 25°C)
	Keyboard	4 membrane keys
	Processor	2 RISC 8 bit, clock 16 MHz
	A/D converter	18 bit resolution (rounded to 16 bit)
	Sample duratation	(rejection 50/60 Hz): 80 ms@rejection 50 Hz
	Environmental limits	-30÷70 °C, 15÷100 % RH (without water condensation)
	Physical protections	onformal coating on the electronic board to protect the board's components against moisture, dust, chemicals, and temperature extremes
	Protection grade	IP 40
	Weight	600 g
	Dimensions	160 x 125 x 50 mm

11 Declaration of conformity

Dichiarazione di conformità / *Declaration of conformity*

Oggetto / *Subject*
Codice prodotto / Product code: ELO3305, ELO3305.1, ELO3105, ELO3515, MDMMB1110, MDMMB1110.1

Descrizione / *Description*
Datalogger ambientale / Environmental datalogger

Fabbricante / *Manufacturer*
LSI LASTEM Srl

Via ex S.P. 161 loc. Dosso 9

20049 Settala (MI) – Italy

Dichiarazione / *Declaration*
Dichiariamo che i prodotti oggetto di questo documento sono stati progettati in accordo e compatibilmente alle seguenti Direttive Europee e norme armonizzate / *We declare that the products covered by this document have been designed in compliance with the following European Directives and harmonized standards:*

2014/30/EU – Direttiva sulla compatibilità elettromagnetica EMC / *EMC electromagnetic compatibility directive.*

EN 61000-6-1: 2007, EN 61000-6-2: 2005– Norme generiche relative all'immunità elettromagnetica riferita ad ambienti residenziali ed industriali / Generic standards for electromagnetic immunity in residential and industrial environments.

EN 61000-6-3: 2007+A1:2011+AC:2012, EN 61000-6-4: 2007+A1:2011 – Norme generiche relative alle emissioni elettromagnetiche riferita ad ambienti residenziali ed industriali / Generic standards for electromagnetic emissions in residential and industrial environments.

2011/65/EU – Direttiva sulla restrizione dell'uso di determinate sostanze pericolose nelle apparecchiature elettriche ed elettroniche. (I nostri prodotti non contengono sostanze definite altamente preoccupanti come definito nell'Art. 33) / *The Restriction of Hazardous Substances Directive. (Our products don't contain the "substances" & "preparations" (Article 33) or release any substances.*

EN 61326-1:2013 – Apparecchi elettrici di misura, controllo e laboratorio – Prescrizioni di compatibilità elettromagnetica – Parte 1: Prescrizioni generali / *Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements*

Il Legale Rappresentante / *Legal Representative*
Andrea Certo

15/01/2021

LSI LASTEM SRL

12 Disposal

This product is a high electronic content device. In accordance with environmental protection and recovery regulations, LSI LASTEM recommends treating the product as a waste of electrical and electronic equipment (RAEE). Its collection at the end of its life must be separated from other waste.

LSI LASTEM is responsible for the conformity of the production, sale and disposal chain of the product, ensuring the rights of the user. Improper disposal of this product will result in law penalties.

Recycle or dispose of the packaging material according to local regulations.

13 Contacting LSI LASTEM

LSI LASTEM offers its assistance service at support@lsi-lastem.com, or filling out the *Request for technical assistance module*, downloadable from www.lsi-lastem.com.

See the following addresses for more information:

- Telephone number: +39 02 95.414.1 (switchboard)
- Address: Via ex S.P. 161 – Dosso n. 9 - 20049 Settala (MI)
- Website: www.lsi-lastem.com
- Commercial service: info@lsi-lastem.com
- Post-sale service: support@lsi-lastem.com