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Modbus Sensor Box

User Manual

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1 Introduction

Modbus® Sensor Box (code DEA485, herein called MSB) is an electronic device produced by LSI LASTEM that allows the easy and fast connection of environmental sensors with PLC/SCADA systems; for instance the photovoltaic applications need frequently interfacing different types of radiance sensor (sometimes with their own calibration factor), temperature sensors and anemometers with the systems for supervision and monitoring of the installations.

MSB assures flexibility, reliability and the LSI LASTEM precision, together with the advantages of a standard communication protocol that has been tested on-the-job for years: Modbus RTU®.

The instrument measures the following parameters:

- Nr. 1 voltage channel for the measuring of signals coming from radiometers (pyranometers/solarimeters) or from generic voltage or current signals 4 ÷ 20 mA;
- Nr. 2 channels for temperature sensors with Pt100 thermal resistance;
- Nr. 1 channel for frequency signal (taco-anemometer).

The *sampling rate* (reading cycle of the input signals) has been set at 1 second. The instrument uses the *instantaneous* date, sampled within a programmable period (*processing* rate) and fixed in advance in order to supply a set of statistic processings; both the instantaneous data and the statistical processings can be transferred by means of Modbus protocol.

MSB is housed inside a small, proof container that can be easily installed.

1.1 Notes about this manual

Document: INSTUM_00885_en - Update on the 15th April 2014.

2 Product installation

2.1 General safety rules

Please read the following general safety rules in order to avoid injuries to people and prevent damages to the product or to possible other products connected with it. In order to avoid any damages, use this product exclusively according to the instructions herein contained.

The installation and maintenance procedures must be carried-out only by authorized and skilled service personnel.

Install the instrument in a clean, dry and safe place. Humidity, dust and extreme temperatures can deteriorate or damage the instrument. In such environments we recommend the installation inside suitable containers.

Power the instrument in a suitable manner. Pay attention and observe the power supplies like indicated for the model in your possession.

Carry-out all connections in a suitable manner. Pay strict attention to the connection diagrams supplied with the instrument.

Do not use the product in case of suspected malfunctions. In case of suspected malfunction, do not power the instrument and contact authorized technical support immediately.

Do not set working the product in presence of water or condensing humidity.

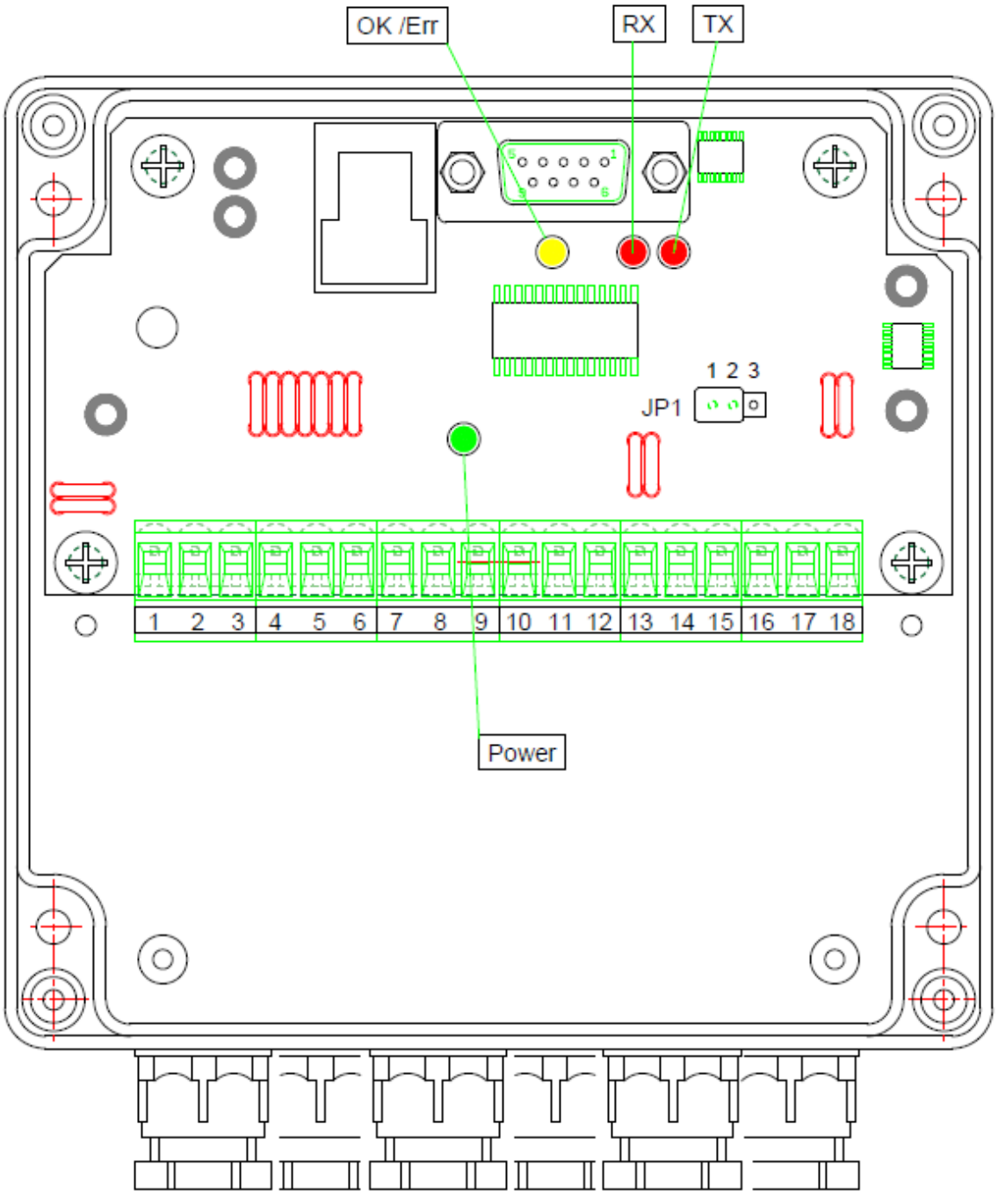
Do not set working the product in an explosive atmosphere.

Before you carry-out any operation on electrical connections, power supply system, sensors and communication apparatus:

- Disconnect the power supply
- Discharge the accumulated electrostatic discharges touching an earthed conductor or apparatus

2.2 Internal components layout

Picture 1 shows the components layout inside the box. The terminal block is connected to a Pt100 sensing element, usable for measuring the instrument internal temperature; this is referred as *Temperature 2* sensor. If you wish to use the instrument input as an additional measuring point, compared to those already available *Temperature 1*, you can remove the Pt100 sensor and use the terminals for the external temperature sensor.



Picture 1

2.3 Mechanical fastening

The installation of the apparatus can be carried-out on the wall by means of 4 plugs, *Fischer* type, and 6 mm screws, using the holes placed on the back panel.

MSB is a precision measurement apparatus, but it is subject to thermal creep (even though minimum); for this reason we recommend to place the apparatus in a shady area and safe from atmospheric agents (even if it is not expressly necessary).

2.4 Electrical connection

Power the instrument according to the technical specifications. Particularly you will get the correct operation using the suitable earthing of the power lines and communication lines.

Under the cover of the box you can find the diagram that shows the electrical wiring of the RS-485 communication line and sensors; it's summed up through the following table:

Clamp	***Name***	***Meaning***
1	Power In +	MSB Power, positive
2	Power In -	MSB Power, negative
3	Gnd	Earthing
4	Gnd	Earthing
5	RS-485 D+	Serial Line 1 - positive RS-485 (non-inverting signal)
6	RS-485 D–	Serial Line 1 - negative RS-485 (inverting signal)
7	Temp. 1 – 1	Temperature sensor input Pt100 nr. 1, wire 1
8	Temp. 1 – 2	Temperature sensor input Pt100 nr. 1, wire 2
9	Temp. 1 – 3	Temperature sensor input Pt100 nr. 1, wire 3 common to wire 2 (*)
10	Temp. 2 – 1 (**)	Temperature sensor input Pt100 nr. 2, wire 1
11	Temp. 2 – 2	Temperature sensor input Pt100 nr. 2, wire 2
12	Temp. 2 – 3	Temperature sensor input Pt100 nr. 2, wire 3 common to wire 2 (*)
13	Dig. +Out	Digital input, anemometer photodiode power
14	Dig. +In	Digital input, anemometer phototransistor power/ A contact
15	Dig. Common	Digital input, common/ B contact
16	Gnd	Earthing
17	Rad./Voltage In +	Radiometer input/tension, positive
18	Rad./Voltage In -	Radiometer input/tension, negative

(*) Wire 3 is used for line compensation; it is connected to the Pt100 sensor in the same point where wire 2 is connected too. Avoid to connect a shortcut bridge between wire 2 and 3 on the MSB terminal board: in this way the line resistance compensation does not work properly and consequently the temperature reading is altered by the line resistance. It is also not correct, in case of use of a 4 wire Pt100 sensor, short-circuit the wires 3 and 4: in this case leave disconnected the wire 4. Please use as a reference the connection diagram under the MSB box cover.

(**) Temperature 2 is supplied from factory via a Pt100 sensor for measuring MSB internal temperature. Remove this sensor from the terminals block if this input is need to be used for an external temperature sensor.

At first perform the connection of the sensors running the cables inside the holes of cable-guides; the unused cable-guides must be closed, using, for example, one piece of cable. Tighten the cable-guides appropriately in order to avoid the seepage of dust, humidity or animals inside the container.

At the end connect the power supply cables. The lighting of the green led on the MSB card confirms the presence of electrical current (see §6.2).

In principle we recommend to divide the power supply lines from the measurement lines used for the connection of the sensors with MSB, in order to reduce the possible electromagnetic disturbances to a minimum; so avoid the use of the same raceways for these different types of wiring. Use line terminations on both the ends of the RS-485 bus using 120 Ω resistors.

2.4.1 Serial line 2

The connection to the serial communication line nr. 2 is carried-out through female 9 pin connector available inside the instrument. Connect MSB to PC using a standard DTE/DCE cable (not inverting). MSB uses Rx/Tx signals only, so the 9 pin D-Sub connector cabling can be reduced to only use poles 2, 3 and 5.

3 System programming and management

MSB is equipped with several functions that can be programmed easily through a terminal emulation program (for example *Windows HyperTerminal* or any other commercial or free program that can be downloaded from Internet).

The programming of the apparatus is carried-out connecting the PC serial line (through USB/ RS-232 adapter or native) to the serial line 2 of MSB (see §2.4.1). The terminal program has to be programmed as follow:

- Bit rate: default 9600 bps;
- Parity: none;
- Terminal Mode: ANSI;
- Echo: disabled;
- Flow control: none.

MSB supplies the access to its functions through an easy menu interface. You can access to the main menu pressing ESC until the terminal program will show the following instructions:

```
Main Menu:
 1: About this device...
 2: Communication parameters
 3: Sampling
 4: Data Tx
 5: Save configuration
 6: Restart system
 7: Statistics
```

The main menu is made up of several items. You can access to the different functions pressing, on terminal, the numeric keypad corresponding to the desired item. The next function may be a new menu or the request to change the selected parameter; in this case it is shown the current value of parameter and the system awaits for the input of a new value; press *Enter* to confirm the new inputted value, or press *Esc* to return to previous menu without changing the selected parameter; the *Esc* key also performs the move to previous menu.

Note: when you need to express decimal values use the dot as decimal separator for numbers input.

3.1 Default settings

Configuration parameters that can be changed with the programming menu have default values, set by LSI LASTEM, as reported in the following table:

Section	*Sub-section*	*Parameter*	*Default value*
Communication parameters	Serial line 1	Bit rate	9600 bps
		Stop bits	1
		Parity	Even
		Network address	1
	Modbus parameters	Swap floating point values	False
		Floating point error value	-999999
		Integer error value	-9999
	Serial line 2	Bit rate	9600 bps
		Stop bits	1
		Parity	None
		Network address	1
Sampling	Voltage input channel	Channel kind	Radiometer
		Conversion parameters	1000 µV/W/m^2 1 mV/W/m^2
	Anemometer parameters - Conversion parameters	Polinomial X^0	0
		Polinomial X^1	0.382948
		Polinomial X^2	-3.35916e-5
	Elaboration rate	Elaboration rate	60 s
Data Tx		Tx rate	0 s (disabled)

3.2 Functions available from menu

The programming menu of MSB offers following functions:

- *About this device…*: to display the registry data of the instrument: mark, serial number and version of the program.
- *Communication parameters*: for each of two communication lines (1= RS-485, 2= RS-232) it allows to program some parameters useful for communication between MSB and the external apparatus (PC, PLC, etc.), particularly:

    - *Bit* rate, *Parity* and *Stop bits*: it allows to modify the serial communication parameters for each of two serial lines. Note that *Stop bit*=2 can be done only when *Parity* is set to *none*.
    - *Network address*: the network address of the instrument. It is especially necessary for Modbus protocol, in order to find (in univocal way) the instrument respect to the others connected on the same RS-485 communication line.

  - *Modbus parameters*: it offers the possibility to modify some parameters that are typical of Modbus protocol, particularly:
    - *Swap floating point values*: it is useful in case the host system requires the inversion of two 16 bit registers, which represent the floating point value.
    - *Floating point error value*: it shows the value used when MSB has to specify an error datum in the registers that collect the floating point data.
    - *Integer error value*: it shows the value used when MSB has to specify an error datum in the registers that collect the integer format data.
- *Sampling*: it includes the parameters that adjust the sampling and the processing of detected signals from the inputs, particularly:
  - *Voltage input channel*: parameters referred to voltage input:
    - *Channel kind*: kind of input (from radiometer o from voltage or current generic signal). Warning: changing this parameter requires the same change in the position of jumper JP1 as indicated by the message text on the terminal.
    - *Conversion parameters*: conversion parameters of voltage signal in the values that represent the measured quantity; in case a radiometer is used, it is needed the entry of a single value that corresponds to the sensitivity of the sensor, expressed in $\mu V/W/m^2$ or $mV/W/m^2$; this value is shown in the calibration certificate of the sensor; in case of input through generic signal are required 4 parameters, relevant to the input scale (expressed in mV) and to corresponding output scale (expressed in the unit of measurement of measured quantity); for example if at voltage input is connected a sensor with output 4 ÷ 20 mA, that correspond to a quantity with scale level 0 ÷ 10 m, and the current signal produces at MSB input, by means of a drop resistance of 50 Ω, a voltage signal from 200 to 1000 mV, for two input/output scales have to be inputted following values respectively: 200, 1000, 0,10.
  - *Anemometer parameters*: it allows to program the linearization factors relative to the anemometer connected to frequency input. MSB supplies the right parameters for the management of LSI LASTEM mod. DNA202 and DNA30x anemometer families; possible other anemometers can be linearized introducing up to 3 factors of the polynomial function that represents the response curve of the sensor. For example, if there is an anemometer with linear response of 10 Hz/m/s frequency, the polynomial will have to be programmed with following values: *X0*: 0.0; *X1*: 0.2; *X3*: 0.0. If instead we have available a table that supplies the values of non-linear response curve, it is recommended the use of a spreadsheet and of the calculation of tendency line of Y-X scatter diagram that represents the data of the table; displaying the polynomial equation (up to third degree) of tendency line, we can obtain the X_n values to be inputted in MSB. Otherwise, in order to obtain the direct value of the frequency, set: *X0*: 0.0; *X1*: 1.0; *X3*: 0.0.
  - *Elaboration rate*: it is the processing time used for the supplying of statistic data (mean, minimum, maximum, totalization values); values included into the correspondent Modbus registries are updated according to the time expressed by this parameter.
- *Data Tx*: this menu allows the execution of a fast diagnostic check of the sampled data and processed by MSB; directly from the terminal emulation program, it is possible evaluate the right signals acquisition by the instrument:
  - *Tx rate*: it shows the transmission rate of data to terminal.

  - *Start Tx*: it starts the transmission according to the specified rate; it is proposed the measures sampled by means of MSB (the display sequence is from input 1 to input 4), updating the display automatically; press *Esc* to stop the transmission of data to terminal.
- *Save configuration*: after request to confirm the operation, it runs the final storage of all changes to parameters previous modified; please note that MSB changes its operation immediately from the first variation of each parameter (excepted the serial bit rates, that need the instrument re-start necessarily), in order to allow the immediate evaluation of the executed modification; re-starting the instrument without the execution of final storage of the parameters, it is produced the operation of MSB corresponding to the situation preceding the modification of parameters.
- *Restart system*: after request to confirm the operation, it runs the restart of the system; warning: this operation cancels the variation of any parameters that have been modified but not definitively stored.
- *Statistics*: this menu allows the display of same statistic data relative to the operation of the instrument, particularly:
  - *Show*: it shows the time from last start or re-start of the instrument, the time from last reset of statistical data, the statistical counts relevant to the communications executed on two serial communication lines (number of received and transferred byte, number of total received messages, wrong messages and transferred messages). For further information about these data read §6.1.
  - *Reset*: it resets the statistical counts.

3.3 Minimal configuration

In order to operate the MSB with its Modbus system correctly, you usually have at least to set as follow:

- *Network address*: the default set value is 1;
- *Bit rate*: the default set value is 9600 bps;
- *Sampling*: it is necessary set the parameters of this menu according to the typical data of the used sensors (radiometer sensitivity, anemometer type).

After modification of the parameters remember to store them definitively through *Save configuration* command and re-start the system in order to make them active (reset button, switch off/switch on or *Restart system* command). It is possible to check if the instrument works in the right way using the *Data Tx* function, available on the configuration menu.

3.4 Restart of the instrument

MSB can be restarted through menu (see §3.2) or acting on reset key placed under the connector of serial line 2. In both cases the changes to configuration, made through menu and not saved, will be cancelled completely.

4 Modbus protocol

MSB implements the Modbus protocol in slave RTU mode. The controls *Read holding registers* (0x03) and *Read input registers* (0x04) are supported for access to acquired data and calculated by the device; both commands supply the same result.

Information available in the Modbus registers regard the instantaneous values (last sampled according to the acquisition rate of 1 s), and the processed values (mean, minimum, maximum and totalization of the sampled data in the period set by the processing rate).

The instantaneous and processed data are available in two different formats: floating point and integer; in the first case the datum is included in two consecutive registers of 16 bit and it is expressed in 32 bit IEEE754 format; the storage sequence in two registers (*big endian* or *little endian*) is programmable (see §3); in the second case each datum is included in a single 16 bit register; its value, as it does not have any floating point, is multiplied by a factor fixed according to the type of measurement it represents and therefore it has to be divided by the same factor in order to obtain the primary factor (expressed with right decimals); the table below shows the multiplication factor for each measurement:

Measurement	***Multiplication Factor***
Voltage (radiometer or generic signal)	10
Temperature	100
Speed of wind/Frequency	10

Take into consideration that the reading of integer values of frequency (if the linearization coefficients have been correctly set , see §3.2 - *Anemometer parameters*) cannot exceed the value 3276.7 Hz.

It is possible use the *Modpoll* program in order to check the connectivity through Modbus in an easy and fast way: it is a free program that can be downloaded from site www.modbusdriver.com/modpoll.html.

You can use Modpoll by command line of Windows or Linux prompt. For example, for Windows version you can execute the command:

```
Modpoll –a 1 –r 1 –c 20 –t 3:float –b 9600 –p none com1
```

Replace *com1* with port really used by PC and, if necessary, the other communication parameters, in case they have been modified in comparison with the default parameters set in MSB. Responding to command the program executes the second query of MSB and displays the results on video display unit. Through –r and –c parameters it is possible fix the measures and their processings that MSB requires. For further information about the commands use –h parameter.

Wanting to use an Ethernet/ RS-232/ RS-485 converter, Modbus requests can be encapsulated inside TCP/IP using this command (for example considering the Ethernet converter available on port 7001 and IP address 192.168.0.10):

```
Modpoll –m enc –a 1 –r 1 –c 20 –t 3:float –p 7001 192.168.0.10
```

4.1 Addresses map

Following table shows the relation between the address of Modbus register and sampled value (instantaneous) or calculated (statistic processing).

Value Type	*Measurement*	*Address*	*Value*
Floating point, 2 x 16 bit	Radiation	0	Instantaneous
		2	Mean
		4	Minimum
		6	Max
		8	Totalization
	Temperature 1	10	Instantaneous
		12	Mean
		14	Minimum
		16	Max
		18	Totalization
	Temperature 2	20	Instantaneous
		22	Mean
		24	Minimum
		26	Max
		28	Totalization
	Speed of Wind	30	Instantaneous
		32	Mean
		34	Minimum
		36	Max
		38	Totalization
Integer, 1 x 16 bit	Radiation	1000	Instantaneous
		1001	Mean
		1002	Minimum
		1003	Max
		1004	Totalization
	Temperature 1	1005	Instantaneous
		1006	Mean
		1007	Minimum
		1008	Max
		1009	Totalization
	Temperature 2	1010	Instantaneous
		1011	Mean
		1012	Minimum
		1013	Max
		1014	Totalization
	Speed of Wind	1015	Instantaneous
		1016	Mean
		1017	Minimum
		1018	Max
		1019	Totalization

5 Specifications

- **Sensors Inputs**
  - Sensors sampling rate: all inputs sampled at 1 Hz
  - Input for voltage signals
    - Scales: 0 ÷ 30 mV; 0 ÷ 1000 mV
    - Resolutions: < 0.5 µV (scale 30 mV); < 20 µV (scale 1000 mV)
    - Accuracy: < ±5 µV (scale 30 mV); < 130 µV (scale 1000 mV)
    - Calibration/scaling: according to the selected use; if by radiometer/solarimeter through sensitivity value noticeable from certificate; if by generic sensor through input/output scale factors
  - Input for Pt100 thermal resistance
    - Scale: -20 ÷ 100 °C
    - Resolution: ≈ 0.04 °C
    - Accuracy: < ±0.1 °C
    - Thermal drift: 0.1 °C / 10 °C
    - Compensation of the line resistance: error 0.06 °C / Ω
  - Input for frequency signals
    - Scale: 0 ÷ 10 kHz
    - Level of input signal: 0 ÷ 3 V, supported 0 ÷ 5 V
    - Signal for power of anemometer photodiode: 3.3 V; 6 mA
    - Signal for power of anemometer phototransistor: 3.3 V; 0.7 mA
    - Resolution: 1 Hz
    - Accuracy: ±0.5 % measured value
    - Linearization/scale adaption: through polynomial function of third degree (default values for LSI LASTEM anemometers, or programmable for different types of sensors)
- **Processing of the measurements**
  - All processed measures with common rate programmable from 1 to 3600 s
  - Application on all measurements of calculations of mean, minimum, maximum and total
- **Communication lines**
  - RS-485
    - Connection on terminal board with two wires (half duplex mode)
    - Serial parameters: 8 data bit, 1 or 2 stop bit programmable (2 stops allowed only when *parity* set to *none*), parity (*none*, *odd*, *even*), bit rate programmable from 1200 to 115200 bps
    - Modbus RTU communication protocol for reading of sampled and processed measures (values expressed in floating point 32 bit IEEE754 format or in 16 bit whole format)
    - Galvanic insulation (3 kV, according to rule UL1577)
  - RS-232
    - 9 poles Sub-D female connector, DCE, used only Tx/Rx/Gnd signals

    - Serial parameters: 8 data bit, 1 or 2 stop bit programmable (2 stops allowed only when *parity* set to *none*), parity (*none*, *odd*, *even*), bit rate programmable from 1200 to 115200 bps
    - Configuration protocol of the apparatus through terminal program
- **Power**
    - Input voltage: 9 ÷ 30 Vcc
    - Protection on polarity inversion
    - Power consumption: < 0.4 W
- **Electrical protections**
    - Against electrostatic discharge, on all sensors inputs, on RS-485 communication line, on power line
    - Maximum power that can be dispelled: 600 W (10/1000 µs)
- **Environmental limits**
    - Operative temperature: -20 ÷ 60 °C
    - Temperature of warehousing/transport: -40 ÷ 85 °C
- **Mechanics**
    - Box sizes: 120 x 120 x 56 mm
    - Fastening holes: nr. 4, 90 x 90, size Ø4 mm
    - Box material: ABS
    - Environmental protection: IP55
    - Weight: ≈320 g

6 Diagnostic

6.1 Statistical information

MSB collects some statistics data that can be useful for diagnostics of possible operation problems. The statistics data can be obtained through menu for programming and management of the system (see §3.2) and through the proper menu entry.

The activation of display of statistics data produces the following result:

```
Power on time: 0000 00:01:00
Statistical info since: 0000 00:01:00

Com Rx bytes Tx bytes Rx msg Rx err msg Tx msg
1 0 1 0 0 0
2 11 2419 0 0 0
```

Here below you can read the meaning of displayed information:

- *Power on time*: power-up time of the apparatus or from last reset [dddd hh:mm:ss].
- *Statistical info since*: time from last reset of statistics [dddd hh:mm:ss].
- *Com*: number of serial port of apparatus (1= RS-485, 2= RS-232).
- *Rx bytes*: number of bytes received from serial port.
- *Tx bytes*: number of bytes transferred from serial port.
- *Rx msg*: total number of messages received from serial port (Modbus protocol for serial port 1,TTY/CISS protocol for serial port 2).
- *Rx err msg*: number of wrong messages received from serial port.
- *Tx msg*: number of messages transferred from serial port.

For further information about the above information look it up in the §6.1 .

6.2 Diagnostic LEDs

Through the lighting of led mounted on electronic card, the instrument shows the following information:

- Green led (Power): it lights to signal the presence of power supply;
- Red leds (Rx/Tx): they signal the communication with host;
- Yellow led (Ok/Err): it shows the operation of the instrument; the flashing type of this led signals possible operation errors, as you can see in the table below:

Flashing type	***Meaning***
Single fast flashing with pause of three seconds	Standard operation, no errors
Single flashing lasting one second with pause of three seconds	Found not-critical problem that does not compromise the operation of the instrument
Triple flashing lasting 1/3 of a second and then pause of three seconds	Found critical problem, MSB must be checked

Possible errors pointed out by MSB are shown by means of a proper message displayed in the menu of statistics that is proposed during the access to the functions of the instrument through terminal (see §3.2); the access in the statistic menu produces the reset of the error signaling (also through led), till next error detection. For further information about the errors managed by the instrument look it up in §6.3.

6.3 Trouble shooting

The table below shows the causes of some problems detected by the system and the pertinent remedies that it can be adopted. In case of errors detection by the system, we recommend to check the statistical data too (§6.1) in order to have a complete picture of the situation.

Error	***Cause***	***Remedy***
The yellow led shows an error condition	MSB has detected an error during its operation	Use the terminal, connected to the serial line 2 of MSB and display the statistical data; according to the reported code make reference to other instructions of this table
The statistics reports the error 1 or an error message has been reported during the final storage of the modifications of configuration parameters	It has been found a storage error of configuration parameters after their modification	The memory (store) of the instrument has an heavy malfunction that probably cannot be recovered; enter again the storage command; in case of persistence of the error contact LSI LASTEM after-sale service. In this situation the calibration parameters of MSB can have been compromised; be sure that the measurements carried out by the apparatus are correct (indicatively); for example using reference signals instead of sensors, before you consider the problems like solved
The statistical reports the error 2	The instrument has restarted and the configuration memory is damaged	Try to restart the instrument checking if the signaling of non-valid configuration persists; in case of persistence of the error contact LSI LASTEM post-sale service
The statistics reports an error higher than 2	It is a non-serious error caused by the survey of a condition of internal invalid operation	Try to restart the instrument; if, within some hours of operation in standard operating conditions (sensors acquisition and active Modbus communication) , you'll find again the problem, try to reduce the bit rate or the query rate of the instrument from the outer apparatus; check the power supply and the signals generated by the sensors; check the grounding quality.
Modbus reports wrong or non-consistent instantaneous values	The cause of the problem can be the wrong connection of the sensors to the terminal board of the instrument, an operation problem of the sensor, a misunderstanding of data from the system connected	Check in the order: 1. The right connection between the sensors and the terminal board, according to the instruction of electric diagram; don't forget the applying of the jumpers, where specified; 2. The operation of the sensor, disconnecting it from MSB terminal board: in case of radiometer measure the voltage at the ends through a voltmeter and check that measurement is included into the estimated output scale; in case of Pt100 temperature sensor measure the

	through Modbus, an error of setup of linearization parameters (only for anemometer input).	resistance at the ends of three wires: in a couple it must be around 100 Ω, for the other couple it must measure a value closed to zero; 3. In case of sensor with frequency output, short-circuit the correspondent MSB input and check that the measurement get down to zero; check the correct setup of the linearization parameters; if necessary set up them at *X0*: 0.0; *X1*: 1.0; *X3*: 0.0 in order to obtain the direct value in frequency; check the characteristics of impulsive signal generated by the sensor in comparison with the specifications at §5. 4. The correct access to the information through Modbus: use the corresponding register according to the kind of format (floating point or whole) considered by the system (look it up in §3.2); in case of floating point format try to invert the content of two registers through the proper function (see §3.2); in case of whole format divide the read value by a factor depending on the type of measurement.

7 Maintenance

MSB is a precision measurement apparatus. In order to maintain the specified measurement precision over the time, LSI LASTEM recommends to check and re-calibrate the instrument every two years.

8 Disposal

MSB is a device with high electronic content. In accordance with the standards of environmental protection and collection, LSI LASTEM recommends to handle MSB as waste of electrical and electronic equipment (RAEE). For this reason, at the end of its life, the instrument must be kept apart from other wastes.

LSI LASTEM is liable for the compliance of the production, sales and disposal lines of MSB, safeguarding the rights of the consumer. Unauthorized disposal of MSB will be punished by the law.

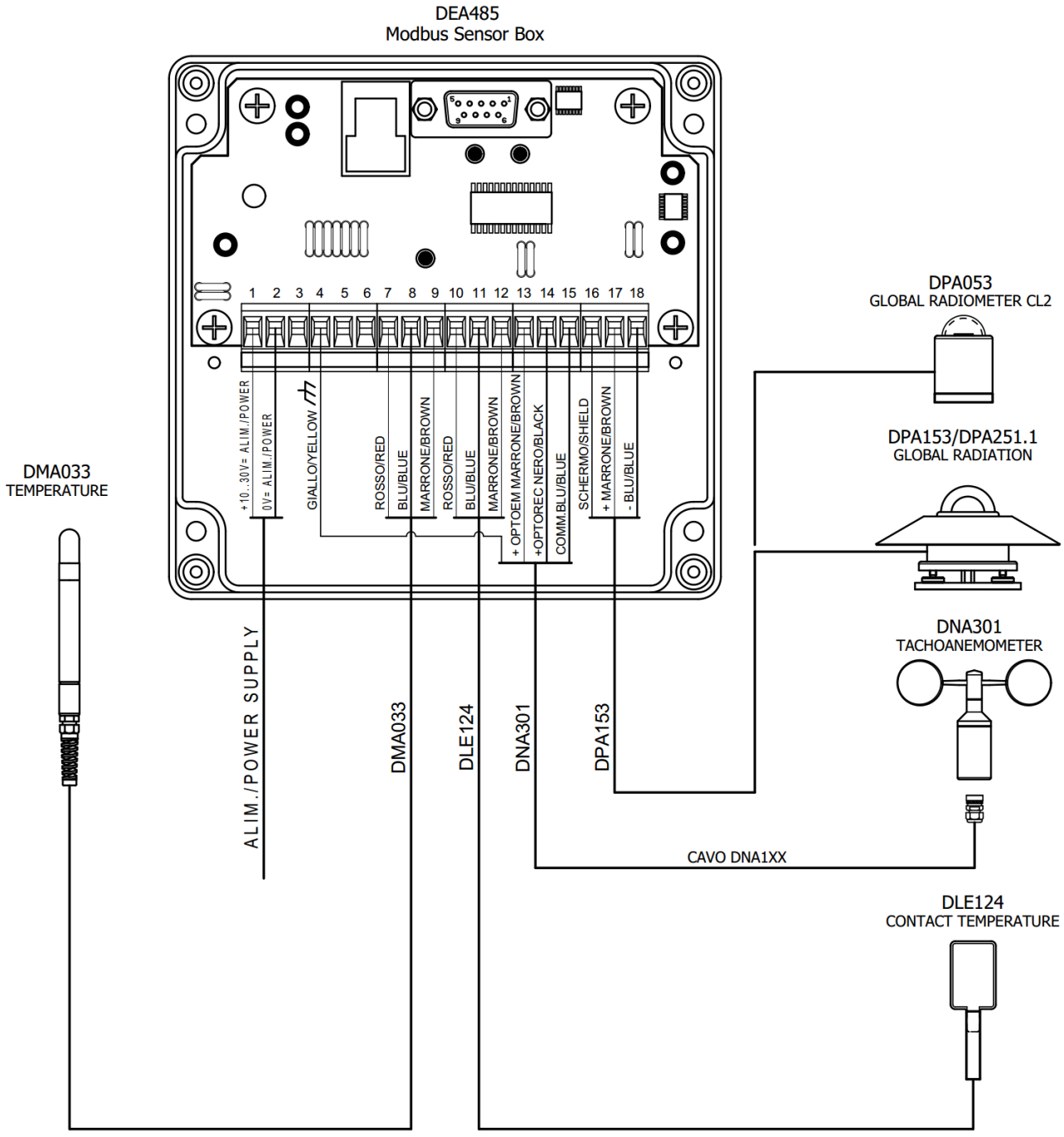
9 How to contact LSI LASTEM

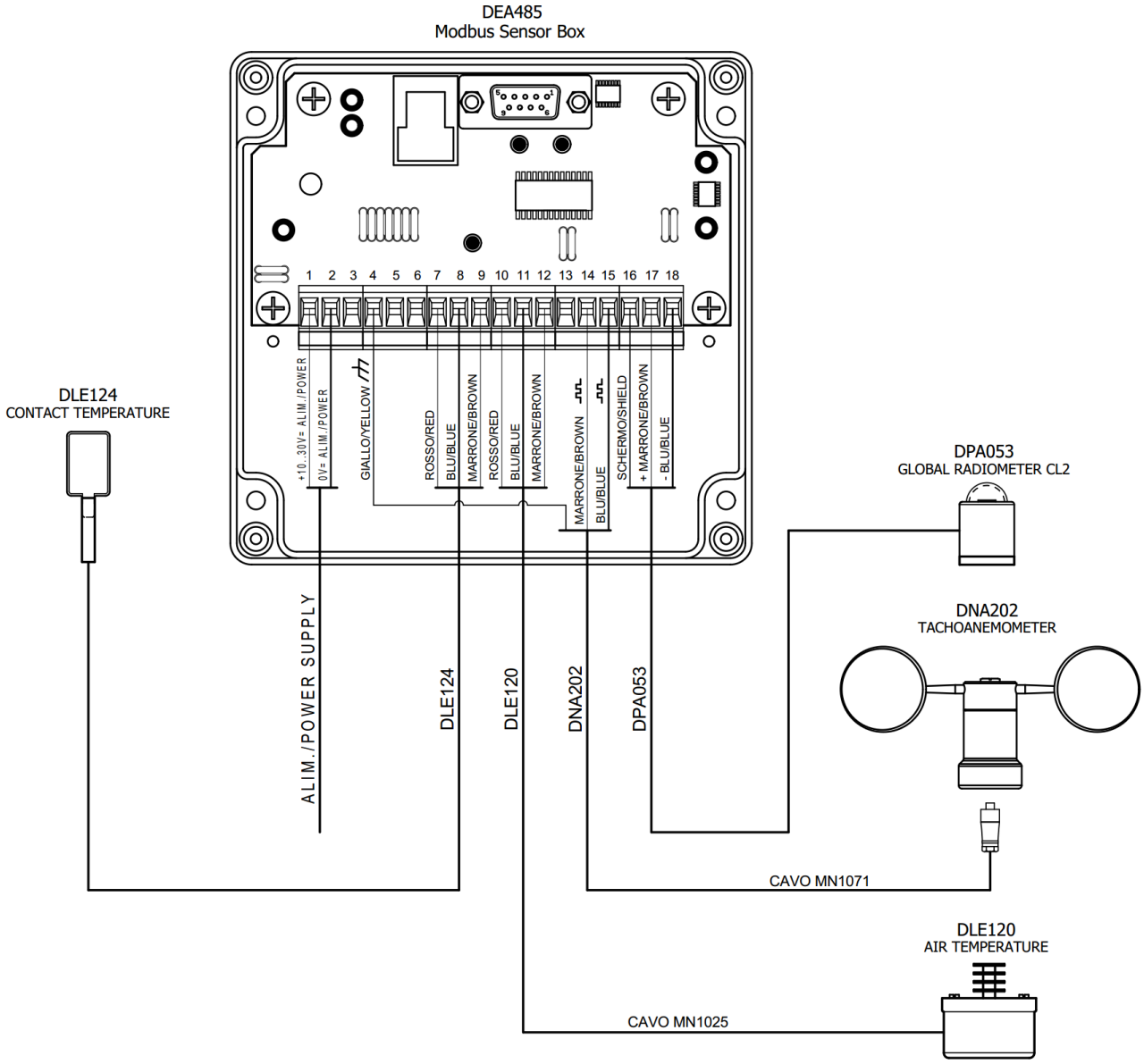
In case of problem contact the technical support of LSI LASTEM sending an e-mail to support@lsi-lastem.it, or compiling the technical support request module at www.lsi-lastem.it.

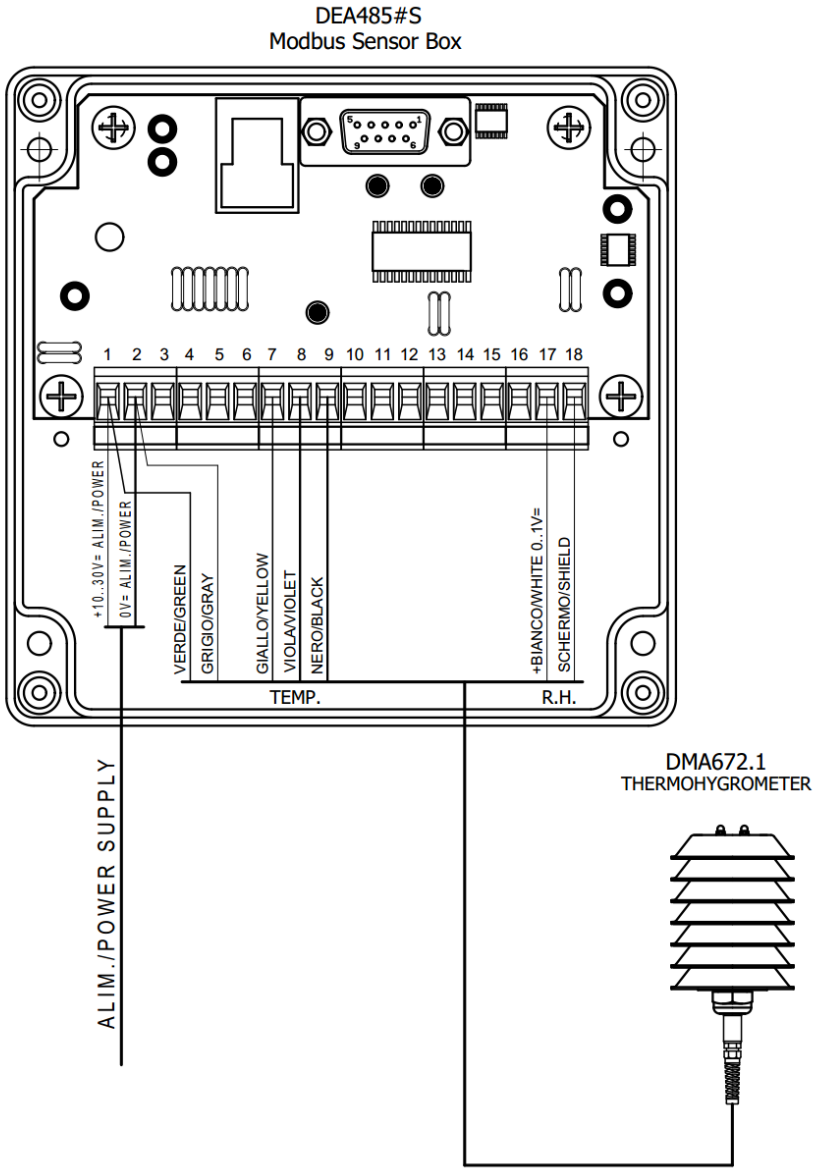
For further information make reference to addresses and numbers below:

- Phone number: +39 02 95.414.1 (exchange)
- Address: via ex S.P. 161 – Dosso n. 9 - 20090 Settala Premenugo, Milano
- Web site: www.lsi-lastem.it
- Commercial service: info@lsi-lastem.it
- After-sales service: support@lsi-lastem.it, riparazioni@lsi-lastem.it

10 Connection drawings




DEA485
Modbus Sensor Box
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
+10..30V= ALIM./POWER
0V= ALIM./POWER
GIALLO/YELLOW
ROSSO/RED
BLU/BLUE
MARRONE/BROWN
ROSSO/RED
BLU/BLUE
MARRONE/BROWN
MARRONE/BROWN
BLU/BLUE
SCHERMO/SHIELD
+ MARRONE/BROWN
- BLU/BLUE
DLE124
CONTACT TEMPERATURE
DPA053
GLOBAL RADIOMETER CL2
DNA202
TACHOANEMOMETER
ALIM./POWER SUPPLY
DLE124
DLE120
DNA202
DPA053
CAVO MN1071
DLE120
AIR TEMPERATURE
CAVO MN1025


DEA485#S
Modbus Sensor Box
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
+10..30V= ALIM./POWER
0V= ALIM./POWER
VERDE/GREEN
GRIGIO/GRAY
GIALLO/YELLOW
VIOLA/VIOLET
NERO/BLACK
+BIANCO/WHITE 0..1V=
SCHERMO/SHIELD
TEMP.
R.H.
ALIM./POWER SUPPLY
DMA672.1
THERMOHYGROMETER

11 CE conformity declaration

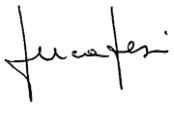
Product description: Sampler/Converter Modbus Sensor Box

Models: DEA485

Issuer: LSI LASTEM Srl

LSI Lastem Srl declare under sole responsibility the above products are made under European directives 2004/108/EC and, specifically to the electromagnetic conformity, with the relevant provision of the following harmonized standards:

- EN 61000-4-2 (1995) + A1 (1998) + A2 (2001): Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test.
- EN 61000-4-3 (2002): Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test.
- EN 61000-4-4 (2004): Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.
- EN 61000-4-5 (1995) + A1 (2001): Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test.
- EN 61000-4-6 (2003): Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields.
- EN 61000-4-8 (1993) + A1 (2001): Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test.
- EN 61000-4-11 (2004): Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests.



Settala, 29 October 2013 Luca Lesi