Bio Instruments S.R.L.

SENSORS AND SYSTEMS
FOR MONITORING GROWING PLANTS

LT-1M

Leaf Temperature Sensor

www.phyto-sensor.com

Introduction

The LT-1M sensor is a subminiature touch probe that measures absolute temperature of a leaf. The lightweight stainless steel wire clip holds a high precision glass encapsulated thermistor, which is about a millimeter in diameter. Small size of the probe and its special design provide almost negligible disturbance of the natural leaf temperature. The thermistor is connected to the clip by thin 0.15 mm leads to minimize heat conduction and response time. All conductors are proofed to avoid corrosion under the wet operating conditions.

The probe is connected by a standard 1-meter cable to the waterproof box with the signal conditioner inside. The output cable length should be specified in the order if required. Every sensor is tuned and calibrated within the measurement range. The tolerance range is ±0.08 ºC .

Installation

Open the clip and attach the sensor to a leaf. Thermistor should be placed at the lower shady side of the leaf.

Secure the sensor's cable on plant stem with adhesive band in order to prevent occasional movement of the sensor.

Selecting Outputs

The LT-1M sensor has the following analog and digital outputs:

Analog: 0 to 2 Vdc, or 0 to 20 mA, or 4 to 20 mA, selected by jumpers;

Digital[1]: RS232, or RS485, or SDI-12, or UART-TTL, selected by micro-switches.

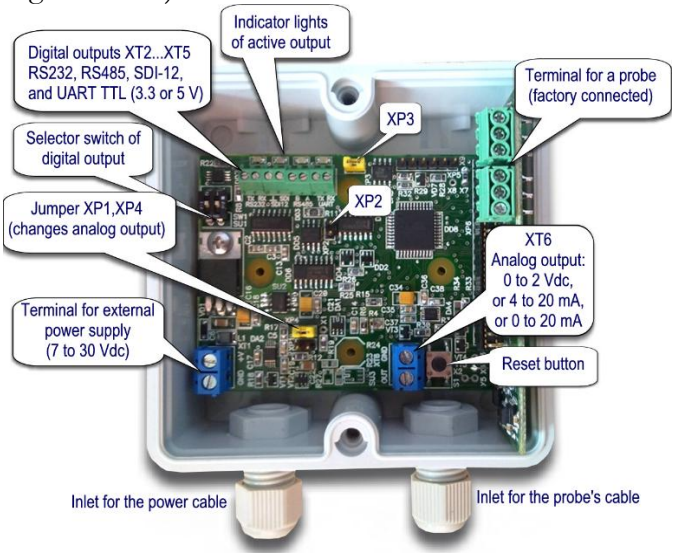
Only one analog output and one digital output may be active at a time.

The appropriate positions of jumpers and switches are described below.

First, please choose a right output cable for connecting the sensor to a datalogger. The cable must be round with four wires for analog outputs and five wires for digital outputs. The maximal diameter of the cable is 6.5 mm. The cable length shall not exceed 10 m for all outputs except current outputs and RS485 with about 1 km maximal length.

[1] Digital outputs are optional, and are provided by special order of the customer.

Run the cable through the appropriate inlet (see Figure below).



Connect according to the desired output:

- Power wires to XT1
- Analog output to XT6
- Digital output to the appropriate contact of the terminal XT2-XT5

Select the desired type of digital output by using the selector switch as follows:

			
RS232	RS485	SDI-12	UART TTL
Position 3-1	Position 2-1	Position 3-0	Position 2-0

Select the desired type of analog output by appropriate position of the jumper XP1,XP4 as follows:

		
0 to 2 Vdc	4 to 20 mA	0 to 20 mA
Jumper on XP4	Jumper on XP1	No jumper

Jumper XP2 is used for the RS485 output if the sensor is the last chain in the line.

Jumper XP3 changes the level of the UART TTL output. If the jumper is on, the voltage level is 3.3 V; in case of no jumper, the voltage level is 5 V.

Power supply

The 7 to 30 Vdc@100 mA regulated power supply may be used for 0 to 2 V analog output, and for all digital outputs.

For current output (4 to 20, or 0 to 20 mA), the minimal power voltage shall be determined from the following conditions:

$U > 0.24\ R_2 + 0.02\ R_1$, and $U > 7 + 0.2\ R_2$

Where R_1 is the value of the input load resistor of the datalogger, and R_2 is the power wires resistance.

Example: $R_1 = 500$ *Ohm, and* $R_2 = 100$ *Ohm.*

$U > 0.24 \times 100 + 0.02 \times 500 = 12.4\ V$
$U > 7 + 0.2 \times 100 = 9\ V$
Therefore, the minimal power voltage must be above 12.4 V.

In case of using the intermittent power supply, please respect the following recommendations:

- Analog outputs require at least 2 seconds

excitation time for producing stable output signal.

- Digital outputs transmit output signal a second after application of power.

Data logging

Digital outputs have the following data format: UART, Baud Rate = 9600, 8N1.

Decimal data format: XX.XX (°C).

When using analog outputs, all possible measures for reducing instrumental errors shall be undertaken:

- Screened cables.
- Cables with low impedance.
- Twisted pair cables.
- Filtration of the signal with low cutoff frequency.
- Isolated power supply and data logger.
- Digital filtration of the signal.

Calibrations table

U,Volts	I, mA	T, °C
0.000	4.00	0.0
0.200	5.60	5.0
0.400	7.20	10.0
0.600	8.80	15.0
0.800	10.40	20.0
1.000	12.00	25.0
1.200	13.60	30.0
1.400	15.20	35.0
1.600	16.80	40.0
1.800	18.40	45.0
2.000	20.00	50.0

Calibrations equations

Linear fit:

LT-1M *model:*

$$T = 25 \times \mathbf{U}$$

LT-1Mi *model:*

$$T = 3.125 \times \mathbf{I} - 12.5$$

Where: **U** – output voltage in Volts

I – output current in mA

Specifications

Measurement range	0 to 50 C
Outputs	0 to 2 V; 4 to 20 mA; 0 to 20 mA RS232; RS485; UART TTL SDI-12
Instrumental accuracy	< 0.15 C
Tolerance range	±0.08 C
Probe weight	1.6 g
Contact area of thermistor	About 1 mm^2
Supply voltage	7 to 30 VDC
Current consumption	30 mA approx.
Probe dimensions, mm	50 W × 20 H × 10 D
Output auto update time	5 s
Excitation time	1s
Protection index	IP 64
Cable length between probe and signal conditioner	1 m

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