



Radio sensor

airTHL





INSTRUCTIONS MANUAL

M98250701-03-13A



Safety Warnings & Symbols

<p>DANGER</p> 	<p>Death, serious injury, or fire hazard could result from improper connection of this equipment. Read and understand this manual before connecting the equipment. Follow all installation and operating instructions while using the instrument.</p> <p>Installation, operation, and maintenance of this instrument must be performed by qualified personnel only. The National Electrical Code defines a qualified person as “one who has the skills and knowledge related to the construction and operation of the electrical equipment and installations, and who has received safety training on the hazards involved.”</p> <p>Use always the required personal protective equipment</p>
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<p>WARNING</p> 	<p>Read the instructions manual before using the equipment.</p> <p>If the instructions preceded by this symbol are not met or applied correctly, this can cause personal injury or equipment and / or facilities damage.</p>
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Liability limitations

CIRCUTOR, SA reserves the right to make changes, without previous notice, to devices or specifications of equipment shown in this manual.

The term of the CIRCUTOR guarantee is two years from the date of purchase and is limited to refund of the purchase price, repair free of charge, or replacement of defective equipment that is returned to CIRCUTOR post-sales service within the term of the guarantee.

The latest versions of specifications and the most up to date manuals this equipment are available to CIRCUTOR, SA customers on its web site: www.circutor.com.

Recommendations prior to use

	<p>In order to use the equipment safely, it is critical that individuals who handle it, follow the safety measures set out in the standards of the country where it is being used, use the necessary personal protection equipment, and pay attention to the various warnings set forth in this instruction manual.</p>
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Before handling, modifying the connection or replacing the equipment, the power supply must be switched OFF, and the equipment disconnected.

It is important to use only the connection cables and accessories that are delivered along with the equipment. These products are specially designed for use with this apparatus and comply with current safety standards. Also, it is critical to keep the cables in perfect condition in order to avoid accidents, personal injury and damage to installations.

The manufacturer of the equipment is not responsible for any damages resulting from failure by the user or installer to heed the warnings and/or recommendations set out in this manual, nor for damages resulting from the use of non-original products or accessories or those made by other manufactures.

We recommend using only the original material delivered with the equipment in order to ensure the safety of individuals who handle it and the integrity of the equipment itself.

Inspect the work area before install. Do not use the device in dangerous areas or where there is a risk of explosion. Avoid using the device in wet areas above specified conditions

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1 GENERAL OVERVIEW

1.1 INITIAL CHECK OVER

Upon receiving the equipment, check the following points:

- The equipment meets the specifications of your order
- It has not been damaged during shipping.
- The shipment includes the accessories requested from the manufacturer.

1.2 Standard components and accessories

With the airTHL you must receive a 3,6 Vcc battery

2 GENERAL DEVICE CHARACTERISTICS

The airTHL is a device including a temperature sensor, a humidity sensor and a light sensor. The device transmits data via radio. It belongs to ZB-Connection devices family and its task is to read inputs and send the data to a compatible GATEWAY at regular programmable time intervals. It may generate alarms when adjustable thresholds are exceeded. Modbus address is set trough dip-switches and its role in the network is as an End-Device.

See also the manual on ZigBee network configuration (M98253901-40-13A)

3 ELECTRICAL CHARACTERISTICS

Supply	
Battery	3,6 Vcc
Duration (when 1 transmission/minute at 20°C)	3 years

COMMUNICATIONS	
Sensors to radio network GATEWAY	Radio ; IEEE 802.15.4 compliant
RF range	2405 MHz ÷ 2480 MHz
Modulation	DSSS
RF transmission power	3 dBm (2mW)
Reception sensitivity	-95 dBm
Coverage outdoor / indoor	100m / 30m

USER INTERFACE	
LED indicators	See paragraph 8

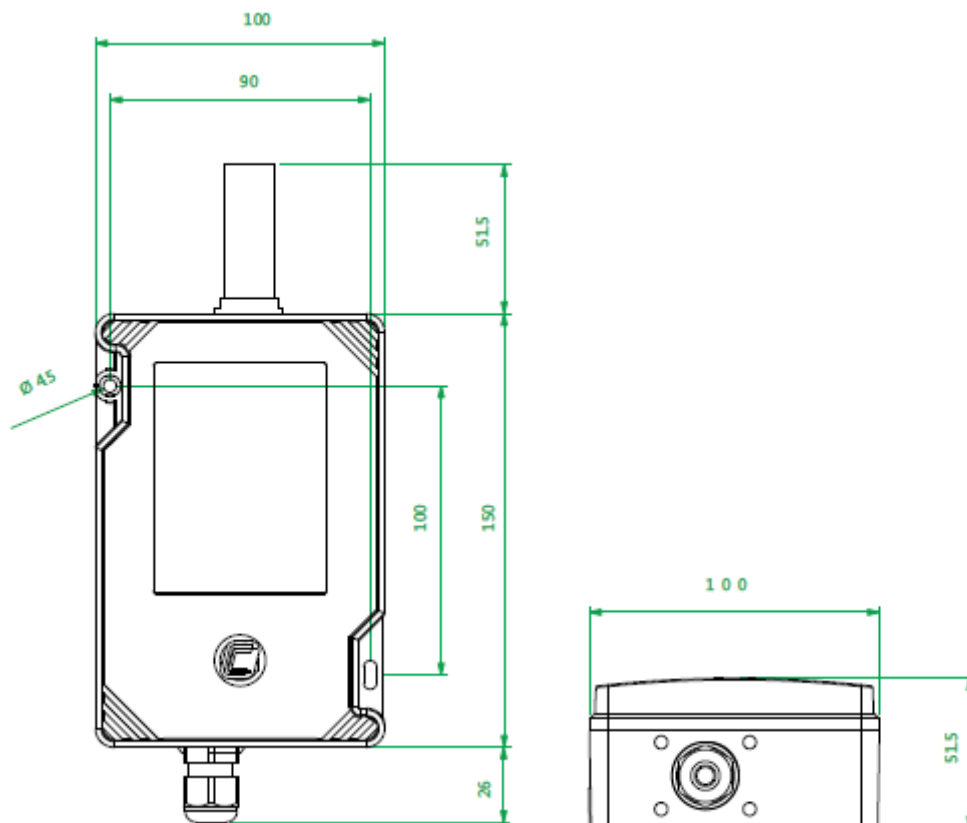
SENSORS CHARACTERISTICS	
Sensors type	Digital
Temperature sensor: Range	-40°C to 120°C
Resolution	±1,5°C
Relative humidity sensor: Range	0 – 100%
Accuracy	± 5 %
Light : Range (depends on the light source spectrum)	10 to 1000 lux
Accuracy	± 5 %

ENVIRONMENT FEATURES	
Working temperature	-10 to 55 °C (10 to 30°C for nominal battery duration)
Storage temperature	-10 ... 60 °C
Relative humidity (without condensation)	80 % RH
Maximum altitude (m)	2.000
Pollution resistance	II
Degree of protection	IP44

MECHANICAL FEATURES	
Weight	217 g
Materials	Polycarbonate
Dimensions	227 x 100 x 51,5
Connections	3,81 mm pitch (pull-out terminals)

STANDARDS	
General Legislation	99/5 EEC (R&TTE Directive) 2004/108 EEC (EMC Directive)
Electrical and radiation safety	EN 60950-1 (2006) +A11 (2009) EN 62479 (2010)
Electromagnetic Compatibility	EN 61000-6-2 (2005) EN 61000-6-3 (2007)
Electromagnetic compatibility and Radio spectrum Matters (ERM)	ETSI EN 301 489-1 v1.8.1 ETSI EN 300 328 v1.7.1 ETSI EN 301 489-17 v1.2.1
Communications	IEEE 802.15.4 ZigBee compatible

4 DIMENSIONS



5 CIRCUIT BOARD AND CONNECTION LAYOUT

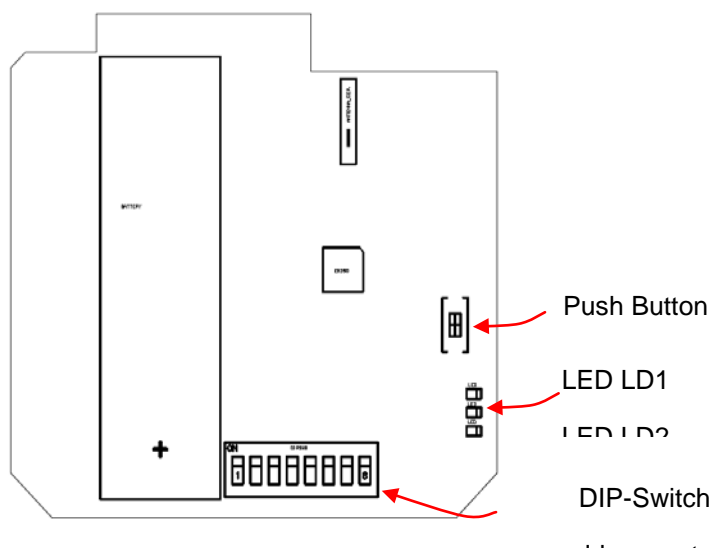


Fig. 5-1. - PCB and connection layout

6 DEVICE ADDRESSING

The device can be addressed by means of a set of dip-switches. Valid addresses range from 16 to 127. **The default configuration is peripheral number 20.**

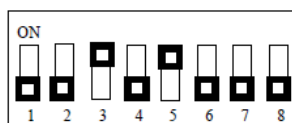


Fig. 6-1. - Address setting dip-switches

The dip-switch is read only when switching the circuit board ON; a modification of the dip-switch position is taken into consideration only after the device has been reset. In order to reset the device, remove the battery, press the pushbutton so that to make the residual energy in the circuit run out and then re-install the battery.

Set the dip-switches before switching the circuit ON and before it has gone into the network.

The dip-switches are read as follows: DIP1 = least significant bit (LSB) ; ON=1, OFF=0

Examples:

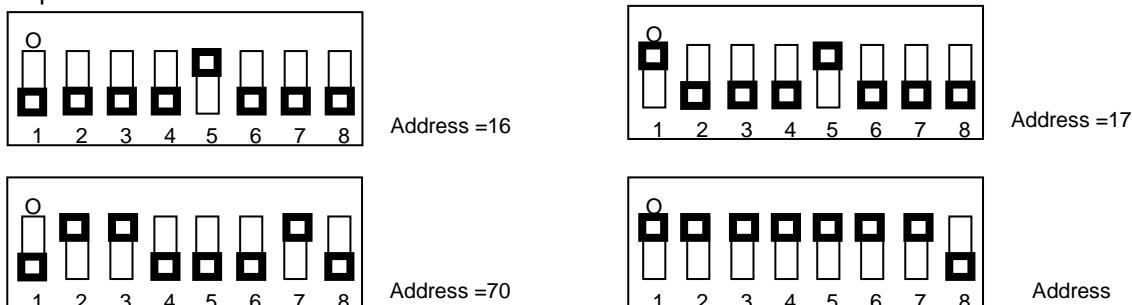


Fig. 6-2.- Examples of address settings

Attention: Be careful when assigning addresses. Two devices with the same address would put their data into the same register in the GATEWAY and this would generate ambiguity which would be difficult to identify in subsequent network operations.

7 ASSOCIATING THE DEVICE TO A COMPATIBLE NETWORK

The process to follow to join airTHL node to a network is the same as for all ZB-Connection end-devices.

The association process is activated by pressing the push button.

The association process is enabled only if the device is not already part of a network, i.e. if it is a new device or if it has been voluntarily disassociated.

1. Press the push button, LED LD2 turns ON and node starts the scanning process of all 16 radio channels in order to find an "open" compatible network (i.e. a ZB-Connection process). The scan process takes about 20 seconds; if the device detects an available network, all 3 LED flash quickly and afterwards they turn OFF (network opening is performed by suitably stimulating the GATEWAY. For more information refer to the GATEWAY operation manual);
2. Otherwise, if the scan process ends without having found any available network, the device goes in a power-safe mode waiting for new push-button stimulating.

8 DISASSOCIATING THE DEVICE FROM THE NETWORK

Disassociating the device from a network involves losing the network parameters and consequently leaving the network of which it had been a part. Moreover device loads to the default value all of its operating parameters (HoldingRegister).

Disassociation can be commanded in two ways:

- Receipt of the appropriate command password.
- Pushing the pushbutton on the card for at least 6 seconds. Disassociation using the push-button is only possible within 20 seconds from when the device is switched ON.

9 DEVICE LED / PUSH BUTTON INTERFACE

airTHL has three LED through which it shows information about its operating status.

The device has also a push button which is used to activate the joining process, to activate disassociation and to stimulate the device in order to send data to the GATEWAY.

9.1 Nomenclature of airTHL LED indicators:

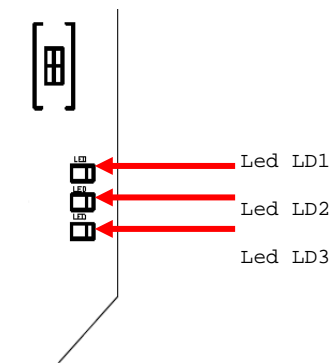


Fig. 6-1.- Nomenclature of airTHL LED indicators

Behaviour of LED indicators at the start-up:

At the reset of airTHL all LED indicators light for 2 seconds, then all of them flash fast for another half second and at the end of flashing the device starts the normal functioning.

How do LED indicators work when airTHL is NOT joined with a network?

When airTHL is NOT joined with a network all LED indicators are OFF

How do LED indicators work when airTHL is joined with a network?

Usually all LED are OFF.

LED LD1 briefly lights ON during acquisition of signals from the sensors and during transmission of a message towards the GATEWAY.

LD2 LED briefly lights ON when receiving an answer from the GATEWAY.

Behaviour of LED indicators during the joining process

LED LD1 lights ON during the whole joining process.

All LED have a fast blinking when there is a successful association with a network.

Radio Link Quality Analysis

The device has a functional mode that permits to know the radio link quality, counting the number of blinkings of led LD3.

This functional mode is activated by pressing the push button (it works only if node is joined to a network) and continues for 60 seconds.

When this mode is active, the node ignores the normal transmission time and transmits a message every 5 seconds. After the successful communication process, the node analyzes the signal strength (RSSI) associated to the message received from GATEWAY. Based on this value the node gives one, two or three flashes of LED LD3.

3 flashes of LD3	-->	RSSI of received message \geq -65 dBm (optimal level)
2 flashes of LD3	-->	-65dBm \geq RSSI of received message \geq -85 dBm (medium level)
1 flash of LD3	-->	RSSI of received message $<$ -85 dBm (low level)

10 DEFAULT PARAMETERS

The device has seven operating parameters, which are saved in its non-volatile memory, and at the moment of initializing are loaded as default settings.

The default parameters are loaded even after device disassociation.

Parameter	DEFAULT	unit
Transmission time	60	[sec]
Threshold of Low Temperature alarm	- 50,0	[°C]
Threshold of High Temperature alarm	+100,0	[°C]
Threshold of Minimum Light alarm	0	[Lux]
Threshold of Maximum Light alarm	100	[Lux]
Threshold of Minimum Humidity alarm	0	[%RH]
Threshold of Maximum Humidity alarm	100	[%RH]
Light multiplicative coefficient (/ 1000)	1000	
Temperature Offset	0,0	[°C]
Temperature measurement unit (0 = Celsius, 1 = Fahrenheit)	0	

11 DESCRIPTION OF THE ACQUISITION PROCESS

The device performs the acquisition of all the values before transmitting its state to the GATEWAY.

Device's sampling interval is equal to Transmission time.

12 DESCRIPTION OF THE ALARM MANAGEMENT PROCESS

The device compares the acquired temperature, humidity and the light level values with the threshold parameters set as alarm limits.

The alarm warning's activation is not delayed. Should the values acquired be over or under the limit, the relevant fault flag is activated.

If Temperature >	High Temperature limit -->	High Temp. flag alarm: =1
If Temperature <=	High Temperature limit -->	High Temp. flag alarm: =0
If Temperature <	Low Temperature limit -->	Low Temp. flag alarm: =1
If Temperature >=	Low Temperature limit -->	Low Temp. flag alarm: =0
If Humidity >	Maximum Humidity Limit -->	Maximum Humidity flag alarm: =1
If Humidity <=	Maximum Humidity Limit -->	Maximum Humidity flag alarm: =0
If Humidity <	Minimum Humidity Limit -->	Minimum Humidity flag alarm: =1
If Humidity >=	Minimum Humidity Limit -->	Minimum Humidity flag alarm: =0
If Light >	Light Maximum Limit -->	flag alarm: Maximum Light =1
If Light <=	Light Maximum Limit -->	flag alarm: Maximum Light =0
If Light <	Light Minimum Limit -->	flag alarm: Minimum Light =1
If Light >=	Light Minimum Limit -->	flag alarm: Minimum Light =0

13 DEVICE DATA MAPPING

Like almost all ZB-Connection devices, airTHL shows its data through data records

The data records of a particular device reside locally in the GATEWAY, and is made up by data sent via radio and by data generated by the GATEWAY itself.

The GATEWAY allows access in read and write modes to the data records related to the devices belonging to the network through a serial interface using Modbus protocol.

Given the nature of the Modbus protocol, the data are split up into four memory areas:

- Input Registers (16-bit variables in read only mode)
- Input Status (1-bit variables in read only mode)
- Holding Registers (16-bit generally non-volatile variables)
- Coil Status (1-bit variables)

The GATEWAY is compatible with the most common Modbus commands such as single and sequential reading of all memory spaces and single and sequential writing of all holding registers and coil statuses. airTHL device has the following data available:

- (14+5) Input Registers
- Input Status
- (11+1) Holding Registers
- 16 Coil Status

13.1 airTHL Input Registers ***

InputRegister[0]	Device Type (=1)
InputRegister[1]	Firmware Version (Major/Minor)
InputRegister[2]	Transmission Counter
InputRegister[3]	Signal Level of the last message received by the device (2)
InputRegister[4]	Battery Level (in mils of volts)
InputRegister[5]	Light RMS(expressed in Lux)
InputRegister[6]	Temperature(in tenths of °C)
InputRegister[7]	Light(expressed in Lux)
InputRegister[8]	Humidity (expressed in % Relative Humidity)
InputRegister[9]	Seconds passed since receiving last messages (1)
InputRegister[10]	Counter of messages received from GATEWAY (1)
InputRegister[11]	GATEWAY message receiving instant time (100 * hours + minutes) (1)
InputRegister[12]	Signal Level of the last message received from GATEWAY (1) (2)
InputRegister[13]	Device network address (1)
InputRegister[14]	Copy of InputStatus[0..15]
InputRegister[15]	Copy of InputStatus[16..31] (flag of pending writes of holdingRegister) (1)
InputRegister[16]	Copy of InputStatus[32..47] (not used) (1)
InputRegister[17]	Copy of InputStatus[48..63] (flag of pending writes of CoilStatus) (1)
InputRegister[18]	Copy of InputStatus[64..79] (general pending flag and presence flag) (1)

- (1) These data are not sent from the device but generated by the GATEWAY
- (2) The signal level gives information on the energy values relative to the last hop that the wireless message has completed. The value is expressed in dB+100 and its value ranges from 70 (maximum value) to 8 (very low value).

13.2 airTHL Holding Registers

HoldingRegister[0]	Command password
HoldingRegister[1]	Transmission time (expressed in seconds)
HoldingRegister[2]	Low temperature alarm threshold (expressed in tenths of a degree centigrade)
HoldingRegister[3]	High temperature alarm threshold (expressed in tenths of a degree centigrade)
HoldingRegister[4]	Minimum light alarm threshold
HoldingRegister[5]	Maximum light alarm threshold
HoldingRegister[6]	Minimum humidity alarm threshold
HoldingRegister[7]	Maximum humidity alarm threshold
HoldingRegister[8]	Light multiplicative coefficient (/ 1000)
HoldingRegister[9]	Temperature Offset (expressed in tenths of a degree)
HoldingRegister[10]	Temperature measurement unit (0 = Celsius, 1 = Fahrenheit)
HoldingRegister[11]	Copy of CoilStatus[0..15]

13.3 airTHL Coil Status

CoilStatus[0]	Command password activation
CoilStatus[1]	Not used
...	...
CoilStatus[15]	Not used

13.4 airTHL Input Status

InputStatus[0]	High temperature alarm
InputStatus[1]	Low temperature alarm
InputStatus[2]	High light alarm
InputStatus[3]	Low light alarm
InputStatus[4]	High humidity alarm
InputStatus[5]	Low humidity alarm
InputStatus[6]	Probe Fail
InputStatus[7]	Low Battery
InputStatus[8]	Not used
...	...
InputStatus[15]	Not used
InputStatus[16]	HoldingRegister[0] write pending (1)
InputStatus[17]	HoldingRegister[1] write pending (1)
InputStatus[18]	HoldingRegister[2] write pending (1)
InputStatus[19]	HoldingRegister[3] write pending (1)
InputStatus[20]	HoldingRegister[4] write pending (1)
InputStatus[21]	HoldingRegister[5] write pending (1)
InputStatus[22]	HoldingRegister[6] write pending (1)
InputStatus[23]	HoldingRegister[7] write pending (1)
InputStatus[24]	HoldingRegister[8] write pending (1)
InputStatus[25]	Not used
...	...
InputStatus[47]	Not used
InputStatus[48]	CoilStatus[0..15] write pending (1)
InputStatus[49]	Not used
...	...
InputStatus[63]	Not used

InputStatus[64]	device presence state (validity of agent's data) (2)
InputStatus[65]	General pending status (logic OR of all write pending) (1)
InputStatus[66]	Not used
...	...
InputStatus[79]	Not used

(1) These flags are managed by GATEWAY and are set at the moment of writing a holding register or a group of coil status; they are reset when the device receives the data (this immediately succeeds its transmission).

(2) The device's presence flag is managed by the GATEWAY; it is set when the data present are valid. The flag is reset if the GATEWAY does not receive messages from the device for a period greater than four times the automatic transmission time.

14 SPECIAL COMMANDS - COMMAND PASSWORD

By means of command passwords it is possible to send special commands to the device. The commands are executed when the bit CoilStatus[0] is set to 1.

HoldingRegister[0] (HEX)	HoldingRegister[0] (DEC)	Action
0x1968	6504	Activate device Boot loader
0x1970	6512	Device reset
0x1973	6515	Device Disassociation

14.1 ROUTER-BRIDGE INPUT REGISTERS

InputRegister[40001]	Router-Bridge Device Type (101)
InputRegister[40002]	Router-Bridge Firmware Version
InputRegister[40003]	Router-Bridge EUI64 (bytes 0,1)
InputRegister[40004]	Router-Bridge EUI64 (bytes 2,3)
InputRegister[40005]	Router-Bridge Short ID
InputRegister[40006]	Cost (distance from the GATEWAY in terms of hop)
InputRegister[40007]	Wireless Signal Level of the last message received (dB+100)
InputRegister[40008]	Number of Router-Bridge neighbours
InputRegister[40009]	Number of good Router-Bridge neighbours
InputRegister[40010]	Number of End-Device children of Router-Bridge
InputRegister[40011]	Received message counter

15 IN CASE OF MALFUNCTION

In the event of questions or concerns regarding operation or malfunction of the device, notify to the **Technical Assistance Service (S.A.T.)** of **CIRCUTOR, SA.**

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